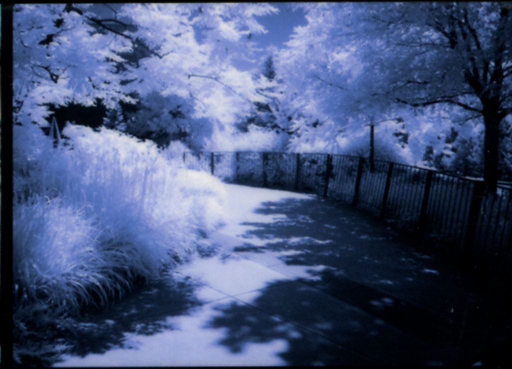



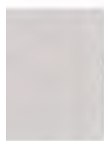

A LARK PHOTOGRAPHY BOOK



Complete Guide to digital Infrared Photography

Joe Farace

contents







foreword

By Rick Sammon




Photo © Rick Sammon

Whenever my Uncle Benny walked into a room and flipped on the light switch, he always announced, "Let there be light." Sometimes he used a more witty approach and said, "Let me shed a little light on the subject." Hey, it may be corny, but Uncle Benny was right about one thing: We photographers would be lost without light.

Technically speaking, when we take pictures we're recording visible light on a piece of film or a digital imaging sensor. That's why it's important to closely observe a scene's lighting conditions before we make a picture.

But what about invisible "light," such as infrared radiation?


Photo © Joe Farace

One of my earliest photographic memories was watching my mother hand color a black-and-white picture. For me, it was magical to see the picture's transformation from black and white to color. That's exactly how I feel about digital infrared (IR) photography. If you want to create pictures with a unique look, consider digital IR. That's where this book and Joe Farace come in. Joe will show you how to produce infrared images using a digital camera as well as how to convert pictures that were previously "straight" photographs.

Joe is my very dear friend and was technical editor for several of my books, so he's the best guy to tackle a technical subject like infrared photography. He has not only written over twenty books on photographic technique and technology, but is also author of the "Digital Innovations" column that appears regularly in *Shutterbug* magazine.

But Joe is not a geek, and this isn't a geeky book; it's all about having fun with digital infrared photography—both in camera and in the digital darkroom. (Uncle Benny liked to have fun, too.) One of the things I admire about Joe's writing is his ability to make seemingly complex techniques understandable to even a beginning photographer. So buckle your seat belt, it's going to be a fun ride. Let's travel with Joe down the infrared highway.



Photo © Joe Farace


Photo Joe Farace

introduction

"Results are uncertain, even among the most experienced photographers." Mathew Brady





Mathew Brady was probably referring to the daguerreotype process, but he could have just as well have been talking about infrared (IR) photography. Creating digital IR images is not overly complicated, but it does require a certain amount of knowledge and practice. The element of surprise, however, is one of the aspects that keeps digital infrared photography fun and challenging.

I expect that you already know how to make a properly composed and exposed photograph, maybe even using the camera's Manual exposure mode. This book comprehensively explores digital infrared photography. It therefore is not a primer on photography; you can find that information in other Lark Book publications such as *The Joy of Digital Photography* and *Mastering Black and White Digital Photography*.



The first image was photographed in full color. The second is a standard black-and-white conversion, produced with image-processing software. The third is an **IR** photograph, which was shot with a Canon digital SLR specially modified for infrared photography. Photos © Rick Sammon.

Welcome to the World of Infrared

Astronomers have long used the infrared spectrum for astrophotography. There are also plenty of scientific applications for terrestrial infrared photography, including forensic investigation and aerial surveys of crops or forests. But you did not buy this book for those reasons. Part of the fun of photography is trying new things. Digital IR photography helps you look at your world in a new way and lets you create otherworldly images that appear unlike those from any other technique you're likely to try. That alone is a good enough reason to try infrared digital photography.

Look at the photo on this page. The surprising tone shifts and starkness, the ethereal white grass and soft-looking leaves, the dark and brooding sky: These are the hallmarks of black-and-white IR photography. This is an often invisible world made possible by infrared recording techniques.





Infrared color photographs often have a fairy-tale look because colors are topsy-turvy. IR color film renders infrared-reflecting plants in orange to purple-red tones, while the use of camera filters can suppress the blue and green components that are also present. You can work in the digital darkroom using software to create IR color film effects.

What is Infrared Light?

Technically speaking, infrared is invisible radiation rather than light. I shall, however, sometimes refer to "infrared light" in order to describe what your camera is recording during the process of infrared photography.

We normally use visible light to create photographic images on digital sensors or film. What humans see as red, orange, yellow, green, blue, indigo, and violet are really different wavelengths of light. The waves get longer as they approach the red portion of the spectrum. Every color's wavelength is measured in



As with all things related to digital IR, there are many ways to accomplish what you want. Here, a conventional, full-color image was shot in available light with a Canon EOS digital SLR. Next, a "faux" monochrome IR version of the image was created with image processing software using techniques that will be described later in the book. Finally, as you will discover as you read through these pages, true IR color can only be photographed using special films such Kodak's Ektachrome Profession IR slide film, but the effect can be simulated using digital darkroom techniques as shown in the third version of the photograph.

nanometers (nm: one billionth of a meter) or microns (one millionth of a meter—sometimes the term millimicron is used interchangeably with nanometer).

Red light begins at wavelengths of about 650 nanometers. Violet light has wavelengths around 400 nm, while yellow light waves are around 575 nm. Immediately above and below the visible light spectrum are wavelengths that we cannot see with the naked eye. Ultraviolet rays are shorter than violet light, ranging from about four nm to 380 nm. Infrared wavelengths of 700 nm are longer than visible red (give or take a few nanometers). This marks the beginning of the infrared spectrum, which extends to wavelengths of one million nm. Though this band of radiation is invisible to our eyes, it has some of the same properties as visible light; for example, it can be focused and reflected. And just like visible light, IR wavelengths can be polarized.

We don't use the full spectrum of infrared radiation for infrared photography. Our primary concern is the range of IR wavelengths between 700 and 1000 nm-closest to visible red. This near infrared (NIR) is the range that is most readily recorded by the sensors in today's digital cameras.



This church was shot on Kodak Ektachrome Professional Infrared film using a Nikon film SLR with a Nikon R60 red filter (which is similar to a standard 25A red filter). The exposure was made by setting the camera to ISO 200 and bracketing like crazy. Digital technology has made IR photography much more convenient for the average photographer, making the special handling required for creating images with film virtually a thing of the past.

A Note about Infrared Film

To better understand how digital infrared photography works, let's first quickly consider the world of film IR photography. You will then understand why digital technology has made infrared photography more accessible to amateur photographers than it used to be.

Photographers have long used infrared films that are not only sensitive to infrared radiation, but also to a portion of ultraviolet and all visible-light wavelengths. These films gave photographers the ability to make pictures with that special "IR look."

However, IR films are less stable than other photographic emulsions. Thus they are difficult to use and process due to special handling requirements. You have to unload your IR film in total darkness and, most likely, process it yourself or find an ever-dwindling pool of specialty labs to do it for you. No such special handling is required with digital photography: You can make prints directly from your memory card.

What's in This Book?

First we will discuss how to capture IR images directly using a digital camera. Next we will look at how to create the infrared look by converting digital files into virtual (or faux) IR images in black and white or color. This section will be as cross-platform as possible. A recent version of Adobe Photoshop was used to process most of the illustrations in this book, but many other image-processsing programs offer similar tools.

The "third half" (as they say on NPR's "Car Talk") of this book is about what to do with IR images after you create them. That's an important part of the fun of IR photography.

So let's have some fun and make a few digital IR images...

Getting the Image on Your Sensor

"Get it on the negative." Leon Kennamer

Digital infrared photography is not merely an esoteric pursuit, but one that is gaining in popularity as digital technology takes over the field of photography. It is an application that has the power to transform mundane visual experiences into images that are unforgettable. Ordinary scenes you might never think of photographing can take on a remarkable look in infrared. If surreal color or dark skies with snow-white foliage and increased contrast appeal to your aesthetic sensibilities, IR is definitely for you.

And what the heck, digital IR is FUN!

Is Your Digital Camera IR Sensitive?

Digital cameras are designed to make pictures using visible light. But nearly all sensors (either CCD or CMOS) used in digital cameras are sensitive to infrared as well. However, because this sensitivity could cause problems with color rendition, exposure metering, and focusing, manufacturers usually place a filter in front of the imaging sensor to prevent excessive infrared light from striking it (but allowing visible light to pass). These internal IR cut-off filters (IIRC), often referred to as hot mirrors, protect the image from color errors and desaturation without reducing ISO speed.

The IIRCs fitted in today's cameras are not uniform in their ability to stop infrared light from striking the sensor. Consequently, some brands of digital cameras (Fuji, Olympus, Sony, and some models from Leica and Panasonic) have a reputation for transmitting more IR light than others. Many compact digital cameras from the earlier days (pre-2002) of digital imaging are known for their IR capability. But that is not to say that other, newer models cannot successfully shoot infrared images.

These before and after shots show the power of infrared photography. The top image is a conventional color digital photograph and the bottom is an IR photo of the same scene shot with a Nikon D1X and a Wratten #87 filter. Photos © Aaron Cathcart.



I have walked past this old farm many times, but shooting it in infrared gave me a new appreciation for the scene. Before shooting, I previewed the IR image on the LCD monitor of my Fuji S20. I used a Cokin P007 filter and made the photograph with the camera set to ISO 200; 1/3 second; f2.8.

If your digital camera is relatively sensitive to **IR,** you can use a special IR filter on the end of your lens to perform the opposite task of a hot mirror: The IR filter will block visible light, thereby allowing infrared wavelengths to pass through the lens to the sensor.

A strong IR capability is a feature that is often overlooked when cameras are reviewed in the photographic press. So how do you know if your camera is capable of photographing IR?



Cleanliness is Next to Godliness

Dust happens, especially in digital SLR cameras. It accumulates on your sensor (or the filter that rests in front of the sensor) during the normal process of changing lenses. You can minimize dust accumulation by keeping your lenses clean and capped and by turning off your camera before changing lenses so power to the chip does not attract even more dust.

If you choose to remove internal dust on your own, use a commercial tool designed for the task and follow the manufacturer's instructions. Please note that some camera companies warn about cleaning imaging chips yourself and state that it may void your warranty. Thus we recommend you proceed at your own risk.

If you still have dust, the safest thing to do is send the camera back to the manufacturer for cleaning.

Test Your Camera for IR Capability

Like everything in digital photography, equipment is changing rapidly, so you'll need to test your own camera to find it's potential to record infrared. How do you do it?

Whenever I get a new digital camera, I give it the "remote control test." What's that? One of the easiest ways to check whether your digital camera is capable of recording infrared images is to activate and point a TV remote control at the camera and take a picture (or look at the subject on the LCD panel of a digital point & shoot).



This digital IR image was recorded with a Canon EOS digital camera modified for IR photography. It was photographed using the color mode setting. 1/125 second; f/8.0; ISO 200.

When photographing the IR-emitting end of the remote control in black-and-white mode (the best way to do this test), you should see a point of white, the brighter the better. If the camera does not record the beam, it is probably not sensitive to infrared radiation.

If your camera passes the test, all you need to do is get yourself an external IR filter or two to fit on the end of your lenses. If your camera doesn't pass, you can still find a way to create infrared images by getting a converted camera.

IR Conversions

There are several services that will convert certain models into IR-only cameras. This process primarily consists of removing the cut-off filter (IIRC) and replacing it with a filter that blocks visible light. Although expensive, a converted camera is highly effective and convenient if you plan on shooting IR frequently.

Once modified, your camera cannot be used for conventional photography; it will be dedicated to IR photography. However, for avid IR shooters, an investment in a converted camera does offer advantages. Since an internal filter is being used to block visible


Here is the result when you convert to black and white with image-processing software.

light, there is no need to use a dark IR filter on the lens. This is a big advantage for digital SLR shooters because it is easier to view your subject to compose and focus. Also, because the IIRC has been removed, the camera is much more sensitive to infrared waves. This allows you to shoot at lower ISOs and/or to set shutter speeds fast enough to handhold your camera. In contrast, a non-converted camera with a filter on the lens almost always requires a sturdy tripod.

The converted camera will only record reflected IR radiation, thus, for example it's not a thermal camera that would allow you see how well the windows in your home are sealed. The retrofitting may also set a custom (called preset by some manufacturers) white balance specifically for IR photography.

The filter used in a typical conversion is delicate and cannot be touched. An optional "hardened" filter may be available. This can be cleaned using conventional means, and that's what I had installed on one of my cameras.

For more information about this process, try a web search for the term "IR camera conversion."



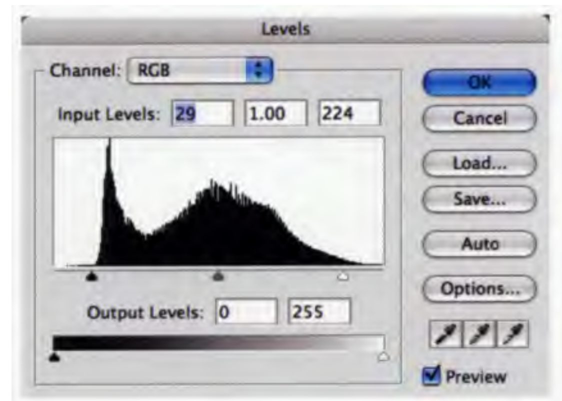
This IR color image was recorded as a JPEG using an IR-converted Canon EOS digial SLR. But I want the classic black-and-white IR look for this photo. 1/320 second; f/8; ISO 200.

Recording and Processing JPEG Images for IR

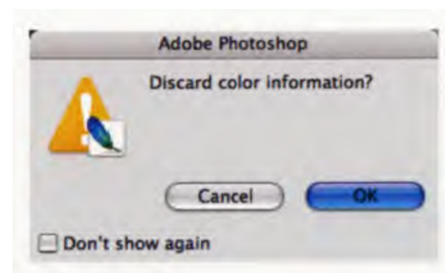
Most digital cameras offer a choice of file formats in which to record, often between JPEG and RAW (and sometimes both simultaneously). Many photographers choose to shoot JPEG files because they take less space on your memory card and often require fewer steps and less time to process.

If your camera does not have a black-and-white shooting mode, it will record a false color IR image. Your IR JPEG images may need a few tweaks in your favorite image-processing program to get them to look the way you expect. There are several ways to do this, and the following steps detail one of the quickest and easiest methods.

Step 1: Open a duplicate TIFF of your JPEG in your image-processing program.



Step 2: Open the Levels dialog window (Image > Adjustments > Levels) and adjust as needed by dragging black triangle just under the left edge of the graph and the white triangle just under the right edge of the graph. This isn't rocket science, so check the Preview box and watch as you make these changes until the image has the look you want.



Step 3: The next step is to convert the file from RGB to Grayscale (Image > Mode > Grayscale). Click OK to discard the color information and create a file that looks like a black-and-white IR photo.

This isn't the only way to accomplish a black-and-white conversion, but it is the simplest. Other methods, including the use of the powerful software tools, are described in the chapter on Creating Digital IR Images.

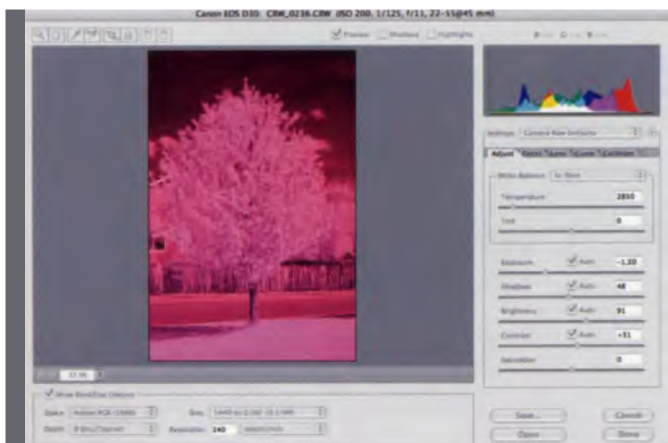


A couple of quick image-processing steps converted the IR color JPEG original to black and white. The depth of field would have been greater had I shot using f/11 instead of f/8, but the photo still works for me (you can read more about focusing and depth-of-field considerations for IR in the next chapter.)

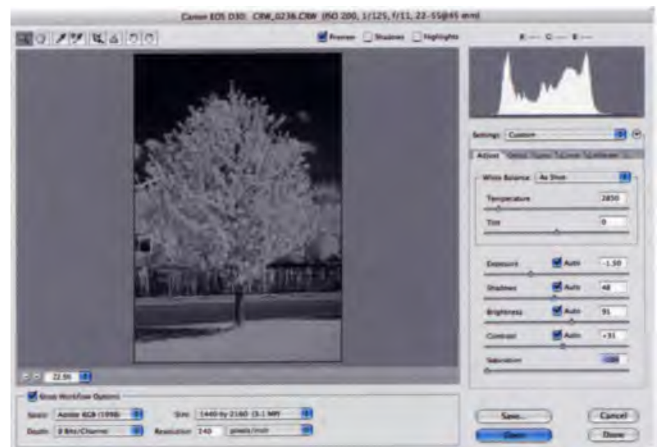
Recording and Processing RAW Images for IR

A camera retrofitted for IR-only capability operates just like an unaltered camera with a few exceptions. You should only use the white balance setting provided by the folks who converted your camera because this setting has been customized to make the images as neutral as possible. (Instructions are usually included with the camera to tell you how to reset it if needed.)

In order to achieve optimum image quality, shoot in RAW mode and save the images as 16-bit TIFF files. However, Adobe Photoshop currently does not recognize the modified white balance provided in converted cameras, so you will need to make adjustments in Camera RAW, an Adobe plug-in that allows you to work on RAW-format files and import them into Photoshop at their maximum quality. (These suggestions apply strictly to Camera RAW 3.0. and higher—earlier versions may be slightly different, but the screenshots provided here should give you an idea of where and how to move each slider to achieve the final result.) This series illustrates what you need to do to achieve the Freaky Friday look of a monochrome IR image.



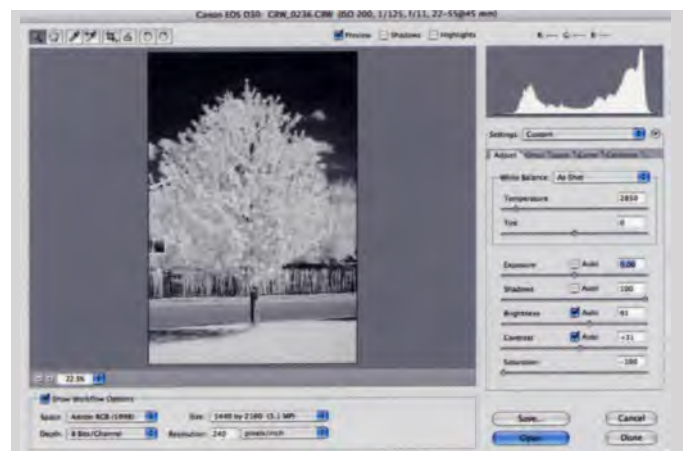
Step 1: Open the image file in Camera RAW via Adobe Bridge (File>Open in Camera RAW).



Step 2: Remove all color by moving the Saturation slider left to -100.



Step 3: Move the Shadows slider to the right (+) to punch up the appearance of depth. As Emeril says, "Season to taste."



Step 4: Move the Exposure slider to brighten the image and you're almost done. For this image, a setting of "0.00" produced the best results. But as you will discover when exploring the wide, wild world of digital IR photography, there are many "rules of thumb" that are not set in concrete.



Here is the final monochrome IR picture processed from a RAW file. A color depth of 16-bits is a good idea to make the most of an image file from a modest three-megapixel camera, such as I used for this picture. (But as you can see from the Depth drop-down menu in the preceeding screen shots, I don't always follow that advice!) 1/125 second; f/11; ISO 200.

Profiles in Infrared: Brody Dezember

Brody Dezember is a professional photographer who works in the Salt Lake Valley of Utah. He specializes in photojournalistic-style wedding photography and often shoots infrared to add a dramatic or dream-like quality to his images. A self-described "computer junkie," Brody was the one of the first photographers in the state of Utah to implement an all digital studio.

Brody's website (www.dezemberphoto.com) features a sophisticated portfolio of posed and candid wedding and portrait work, and includes examples of his black-and-white infrared photographs. It also offers information on IR camera conversions.



Digital infrared photographs can be as beautiful as a new bride. This photograph was shot with an IR-converted Nikon Coolpix 990 and a wide-angle supplementary lens. Photo © Brody Dezember.



This lovely wedding photo was also shot using a Nikon Coolpix 990 with wide-angle supplementary lens. The camera was hand-held and the exposure was made using automatic mode. Sounds simple? You still need to be able see this image in your mind before you capture it. Photo © Brody Dezember.

Focusing and Exposing in IR

"Mysteries lie all around us, even in the most familiar things, waiting only to be perceived." Wynn Bullock

Infrared photography is different in many ways than traditional photography. Aside from recording a separate segment of the energy spectrum, modifications in equipment are needed, shooting techniques are different, and clearly, the results take on a look entirely their own.

For instance, IR reflectivity is affected by many factors, including the temperature and time of the day. With experience, you will look at the window and say, "This is a great day to make IR pictures." Conversely, you'll know when it's a waste of time to shoot infrared because conditions are not right. Often it seems that when the lighting is perfect for traditional photography, it is probably a bad day to make IR photographs. But I like to say, the only rule is "there are no rules," so explore every possible condition. And make notes about them with each image using the captioning capability of your image-processing program.

There are also several technical ways that infrared differs from traditional photography. Important among these are how IR affects focus and exposure.

There are an infinite number of creative possibilities when working with digital IR. This picture was shot using an IR-converted digital SLR. The sepia toning and water effect were added using image-processing plug-ins.





You'll need infrared filters if you want to record IR images using a digital SLR that has not been converted for IR photography. This image was shot along the river walk in downtown Estes Park, Colorado using a Nikon digital SLR with a Wratten #87 filter. Photo © Aaron Cathcart

Focusing Differences

Focusing for IR photography can be a challenge .. . but only if you want to make it one. You may be surprised to learn that even the various wavelengths in the visible color spectrum do not focus on exactly the same plane when passed through a lens. Much like a prism, glass lens elements produce a rainbow of color as light passes through them. This difference in the optical behavior of various wavelengths of visible light is called a chromatic aberration. Over the years the optical engineers at the different lens manufacturing companies have devised formulas and coatings to correct the many types of chromatic aberrations. Lenses described by terms such as achromatic, apochromatic (APO), super apochromatic, and ED glass accomplish this in one way or another.

Most lenses, however, aren't chromatically corrected for IR wavelengths and thus can't focus infrared wavelengths on the same plane as visible light. That's why it may be necessary to adjust the point of focus slightly when shooting infrared images. You might be interested to know that for most photographic lenses, this shift is approximately 1/ 400th of the lens' focal length, but I'll show you less mathematical ways to make sure your **IR** photos are in focus.

Focusing with Digital SLR Cameras

In the past, many manufacturers of SLR lenses placed an infrared mark on their products to help you make this focusing adjustment. If present, it is usually indicated by a red dot or an 'R' on the focusing index, or a curved red line on zoom lenses. This is helpful if you are using such a lens on a non-converted digital SLR that lets you manually focus. Unfortunately, most manufacturers no longer put an IR focus mark on their lenses.

If this focusing mark is on your lens, here's how to use it: Before the IR filter is in place, focus normally. Then rotate the lens' focusing ring so the focused distance appears opposite the infrared focusing mark. Attach the IR filter and shoot.

What about those of you who do not have this type of equipment? Are you tossed out of the IR focusing game? Fear not young padwan, help is on the way.



Some lenses, including this Canon EF 50mm f/2.5 Compact Macro AF lens, have an IR mark for manual focusing. When shooting IR with an opaque filter, set focus before attaching the filter. To do so, focus manually, then set the focused distance opposite the lens' red IR indicator. Finally, attach the filter and shoot.

Hyperfocal Distance

Another way to deal with IR focusing is to use the hyperfocal distance. This is my favorite method, especially when working with wide-angle lenses. It uses depth of field to your focusing advantage.

Though technically there is only a single plane of sharp focus in a photograph, in actuality there is a space in front of and behind the plane of optimal focus that is acceptably sharp. This is the depth of field. When you focus on a subject, a rule of thumb states that this area of depth of field extends from one-third the distance in front of your subject to two-thirds behind.

Imagine that you have focused your lens on infinity. There will be a range in front of infinity that will also be in focus. The closest point to your camera that is still acceptibly sharp is known as the hyperfocal distance. Consequently, any object that is between this point and infinity will also be in focus.

Your goal in using the hyperfocal distance is to maximize the size of this area of depth of field. If you set focus at the hyperfocal distance instead of infinity, you will achieve the greatest depth of field possible, making it extend from half the hyperfocal distance to infinity. This gives you the greatest odds of insuring your subject is in focus.

Depth of Field Scale

After you pick an aperture, such as f/16, rotate the focusing ring so that aperture (f/16) on the depth of field scale is opposite the infinity mark. On the lens below, this gives a depth of field from about 14 inches (between .3 and .4 meters, or about 36 cm) to infinity—more than enough to take care of any focus shift caused by infrared wavelengths.





This photograph was made with a Canon EOS digital SLR that has been converted to IR use. The lens was set at the hyperfocal distance for f/11. 1/250 second; ISO 400.

Hyperfocal Distance

Smaller (APS) Sensor (1.5 multiplier)

Lens Focal Length:	24mm	28mm	35mm	50mm	100mm	200mm
Aperture	**Hyperfocal Distance in feet (meters)**					
f/2.8	34 (10.3)	46 (14.0)	72 (21.9)	146 (44.6)	585 (179)	2343 (714)
f/4	24 (7.3)	32 (9.8)	50 (15.2)	102 (31.0)	409 (125)	1640 (500)
f/5.6	17 (5.1)	23 (7.0)	36 (10.8)	73 (22.3)	293 (90)	1172 (357)
f/8	12 (3.6)	16 (4.9)	25 (7.7)	51 (15.6)	205 (62.5)	820 (250)
f/11	9 (2.6)	12 (3.6)	18 (5.6)	37 (11.2)	149 (45.5)	596 (182)
f/16	6 (1.8)	8 (2.5)	12 (3.6)	26 (7.8)	102 (31.3)	410 (125)
f/22	4 (1.2)	6 (1.8)	9 (2.6)	18 (5.7)	75 (22.7)	298 (90.9)

Full Frame (35mm) Sensor

Aperture	Hyperfocal Distance in feet (meters)					
f/2.8	23 (7.0)	31 (9.5)	48 (14.6)	98 (29.8)	390 (119)	1562 (476)
f/4	16 (4.9)	21 (6.4)	34 (10.3)	68 (20.7)	280 (85.3)	1094 (333)
f/5.6	11 (3.4)	15 (4.6)	24 (7.3)	49 (14.9)	195 (59.5)	780 (238)
f/8	8 (2.5)	11 (3.3)	17 (5.1)	34 (10.3)	137 (41.6)	547 (167)
f/11	6 (1.8)	8 (2.4)	12 (3.6)	25 (7.7)	99 (30.3)	398 (121)
f/16	4 (1.2)	5 (1.6)	8 (2.5)	17 (5.1)	68 (20.8)	273 (83.3)
f/22	3 (.8)	4 (1.2)	6 (1.8)	12 (3.6)	50 (15.2)	199 (60.6)

It's not easy to know the precise hyperfocal distance for any given situation. It is variable depending on the f/stop and focal length you are using, as well as the size of the sensor in your digital camera. The technique is easier to use if your lens has a scale on it for depth of field (a once common feature that is also getting more difficult to find on modern SLR lenses).

Since more and more digital SLRs and almost all other digital cameras are designed with lenses that have no apertures or depth-of-field scales on them, you will have to develop a sense of where the hyperfocal distance lies based on precalculated charts.

Use the chart above to determine the approximate hyperfocal distance in feet or meters from your camera.



This MC Zenita 16mm f/2.8 extreme wide-angle lens was manufactured for film SLR cameras, but it works great with my converted digital SLR too (although it must be manually focused). I prefer to set it at f/16 (or something similar) and then set infinity across from that aperture on the lens' depth-of-field scale. This keeps it in focus from a fraction of a meter to infinity. I never focus the lens. When it's mounted on my converted Canon EOS digital SLR, I treat the combo just like a digital point-and-shoot camera.

IR-Converted Digital SLRs

To account for the back focus change resulting from the removal of the IIRC, the advice from those who make these conversions is to set the aperture at f/11 or smaller. Shooting at small apertures should not be a problem because there are no filters to shoot through when using an IR converted digital SLR.

IR-Converted Advanced Compact Zoom Digital Cameras

Some of these cameras have manual exposure modes that allow you to set the lens aperture; if your camera has this feature, set the smallest aperture available (largest f/number). Sometimes this is only f/8, which may not seem like a large number in comparison to SLR standards. But don't let that stop you from having fun, it is still enough to give adequate depth of field. The ability to stop down farther is often not needed on these cameras, and most of your images won't be intense close-ups anyway.

Focusing with Non-SLR Digital Cameras

My IR shooting technique with these types of cameras is so simple you might call it point-and-shoot infrared. It is important to use a tripod since IR filters are quite dark (see the next chapter for the scoop on ilters), making it nearly impossible to get a sharp handheld exposure. When shooting on a support, I pick an exposure mode based on environmental conlitions. Windy days call for Shutter Priority (Tv). Most other times I simply use Program (P) mode, to keep things simple.Of

course, using the hyperfocal distance is one way to get sharp focus with these cameras. If the camera has an electronic viewfinder (EVF), I first compose and place the filter in front of the lens, then wait for the mage in the EVF settle down and compensate for the ilter's density. You can see the IR effect in the EVF or CD preview screen.

You might think that the image passing through an IR filter may be too dark or lack contrast for the camera to focus, but EVF cameras snap readily into focus. So if you have an EVF camera, let it focus through the filer. If the camera has a black-and-white mode, I use that to get a real preview of the final image.

Exposing for Infrared Wavelengths

Because exposure meters are not sensitive to infrared wavelengths, it becomes difficult to calculate exact exposures. But there are ways to get properly exposed digital IR photographs, especially with digital cameras.

Digital cameras provide instant feedback about the shots recorded on your memory card. Not only can you use the LCD screen to review the picture you've just shot for brightness, but many digital cameras also let you use it to review the histogram, giving you accurate information about how over- or underexposed the picture might be (see page 38). You can often reshoot a picture using different settings or exposure compensation if you determine the exposure is not acceptable.

Bracketing

Another method to help with infrared exposure is bracketing. This means you make several photographs (in this case, three to five is sufficient) of the scene, changing the exposure each time. Most digital SLRs offer a built-in bracketing function that will make a specified series of shots at exposures over and under what is considered normal. Read your manual for directions because every camera is a little different. Even if your camera doesn't have a bracketing function, it should have an exposure compensation feature that will let you adjust exposures in increments of one-half or one-third (my preference) stops while in the various automatic exposure modes.

The series of pictures on the opposite page illustrates bracketing. Which of the shots in the bracketed series is the "right" one. Here's the good news: It doesn't matter. Whatever one you like best is the right one. Don't ever forget they are your pictures, so you have nobody else but yourself to please.

ISO Settings

With digital IR photography, one of the best exposure techniques you can try when getting underexposed shots is to increase the camera's ISO setting. This also increases noise, giving the image a more "IR film" look, which you may or may not like. The trade-off is increasing aperture size (smaller f/numbers), but there you have to do a delicate balancing act between exposure, depth of field, and possibly losing focus on an important part of the image.

Manual Exposure Mode

If all else fails, many digital SLRs offer a Manual exposure mode. You don't need a hand-held exposure meter to get started in Manual mode. Typically I will determine what the suggested exposure is in Program mode, then transfer that shutter speed and aperture to the camera after it's set in Manual mode. Now you are free to change the shutter speed or aperture to bracket exposures.

Bracketing Your IR Photos

This is the original scene before I shot a bracketed series of infrared photographs. The same camera and lens were used, only the exposure and color mode were changed. 1/640 second; f/9; ISO 400.



This series demonstrates the bracketing method used to achieve a properly exposed IR image. I began by first setting the camera to black-and-white mode and mounting a Cokin P007 filter in front of the lens. The Olympus digital SLR used for this series automatically makes three different consecutive exposures by changing the shutter speed when it is in Aperture Priority mode.

The second and third bracketed shots were made at slower shutter speeds as exhibited by the decrease in sharpness of the leaves (compared to the first photo), caused by the wind moving them slightly. So what can be done? Switch to Shutter Priority mode to increase shutter speed or move the ISO setting up. Or maybe you like the blur, so what the heck.

The Proper Exposure

After bracketing a series of images or using your camera's exposure system to set plus or minus compensation values, the next step is to determine which image has the best exposure. You can use your digital camera's LCD screen to look at the images and determine if you need to continue making adjustments to the exposure. But my favorite method involves using the histogram that's built into your camera, probably somewhere in its "INFO" mode. (This will vary with each camera. Read your camera's manual to see if your camera has a histogram and how to review it.)



Shadow details will be lost when the graph falls straight down the left axis.

If you're not familiar with a histogram, don't worry. It's not something the night nurse will be bringing in during a stay at the hospital. In statistics, a histogram is a graphic representation of tabulated frequencies. In digital photography, it's a display of the tones in the image file, ranging from the darkest shadow (the left vertical axis of the graph) to the brightest highlight (the right axis of the graph). Traditional darkroom practitioners might think of it as a digital Zone System with Zone Zero at the leftmost part of the histogram and Zone X at the extreme right.

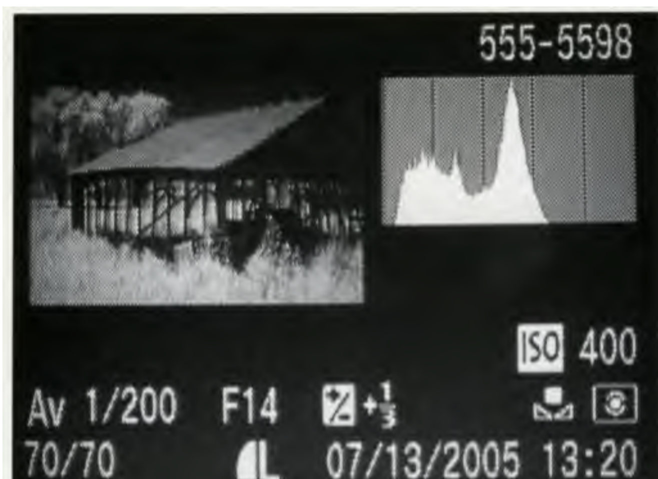


This example of a histogram shows clipping in highlight details as the graph falls straight down on the right axis.

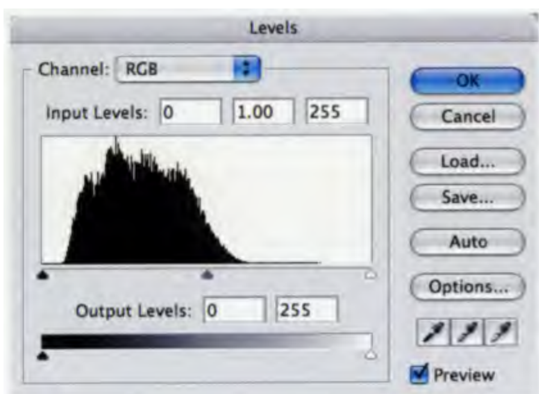
Generally, proper exposure is indicated by a histogram when the graph starts at the intersection of the left vertical axis and horizontal base. The graph will then curve up and down somewhat through the middle tones, and will end just at the intersection of the horizontal base and the right vertical axis. If the graph butts up to either the left or right vertical axes, so that it falls straight down like a cliff, you will see 'clipping' in your image, or loss of detail in the shadows (left side clip) or highlights (right side clip).



This example demonstrates no clipping of shadow and virtually none in highlight detail.



This histogram is from an exposure made with an IR-converted digital camera. The space between the end of the graph and the right axis indicates that no light tones were recorded in the picture. (It is important to note that there is almost always a lot of highlight areas in a landscape-type IR picture because deciduous green plants appear white, remember?) Usually the histogram for a properly exposed image ends just at the right axis.



Here is a histogram as it appears in the Levels option (Image > Adjustments> Levels) in Adobe Photoshop. It displays data in a similar way as the camera's histogram; and like the example from the camera above, it is also underexposed. You can attempt to fix the underexposure by moving the right triangle so it sits just under the end of the right edge of the data curve.

There are two ways deal with histograms: One while shooting, by looking at the histogram on the camera's LCD screen; and the other later, when viewing the image on your computer monitor in an image-processing software program.

Using the camera's histogram allows you to review your picture and reshoot on the spot if required. If the histogram indicates underexposure, you can make adjustments to optimize the image, most typically by applying plus exposure compensation or by using Manual (M) exposure mode to increase the exposure. Be warned that sometimes you will increase exposure and the histogram won't change. That's the nature of IR, and it often varies from scene to scene because some subjects that look quite bright to your eye may be dead in terms of infrared content. In that case, continue to make increasingly stronger exposure adjustments until you see a change, then stop.

However, like nearly all photographic tools, histograms are not the Dead Sea Scrolls. Don't let them rule your life. They merely give you an idea of where to go with exposure. And get this: Sometimes the IR content of an image is zilch. In that case, it's like taking a color picture of a black horse in a field of snow. No matter how hard you try, you're not going to make it have much color. For the most part, you should be able to increase exposure to get data in the right-hand side of the histogram. But remember, we are applying the rules of visible light to invisible light and they don't always translate as neatly as we might like.

I believe it is always best to create the most optimal image possible in-camera rather than depending on image-enhancing software to "fix the image" later after downloading. But I leave this for you to prove to yourself; and besides, sometimes it is hard to see that little LCD screen in bright daylight, so maybe you don't know enough to make adjustments in the field. You may need to enhance the file with image-processing software anyway. That may not an ideal solution, but it's a solution. That's why they call it art!



When I gazed at this scene, it struck me as rather boring. But the trees had potential so I tried to visualize how they would look if shot in infrared. 1/800 second; 1/10; ISO 400. A plus one-stop exposure compensation was used because of the backlit nature of the scene).

The picture looked more interesting when I previewed it in IR with a Cokin IR filter on the lens, so I photographed it at 1/25 second, f/3.6, ISO 400 (right, top). A plus one-stop exposure compensation was used.

My camera has a sepia mode, so just for the heck of it I switched it on and created what I think is the most interesting photograph of the bunch (right, bottom). Who knew? That's why you should never hesitate to experiment. With digital, you can always erase the clunkers. 1/10 second; f/3.6; ISO 400. A plus one-stop exposure compensation was used.

Seeing in Infrared

Photography is usually all about lighting, but IR photography is concerned with invisible wavelengths, which is why comparisons to conventional photography are difficult. If you want to create a dramatic image, few things can beat a beautiful sunrise photographed in color. The same scene photographed in IR may be disappointing unless there is some great IR reflective subject matter (we're talking about big deciduous trees here) to add interest. The "special wood" effect (bright to white reproduction of the chlorophyll layer of deciduous plants in black-and-white images) appears strongest at low sun levels.







It was a dark and stormy day. A plus two-stop exposure compensation was applied based on my assessment of the preview image in the camera's LCD. 1/200 second; f/10; ISO 800.



Backlighting, long a favorite of photographers, often creates dramatic images—both conventional and IR. this picture was shot with a converted Canon LOS. A plus one-stop exposure compensation was applied based on observing the camera's histograms of test exposures. 1/200 second; f/9; ISO 400.

If the lighting looks great for standard photographs, such as portraits in the shade, or sunrise and sunset, the rule of thumb is that it's probably not going to work for IR. But don't take my word for it—you need to experiment for yourself because you'll never know for sure what the results will be. For example, see the illustration opposite of the farmhouse surrounded by trees. Shooting an approaching storm often makes a great "standard" photograph. But I had a feeling that I could make a dramatic digital infrared image as well. The trees should retain some IR reflectance via heat and the storm clouds should add impact, right? Sometimes when you experiment you get lucky, and that's what happened in the middle of a summer day when I was taking my daily walk.

What to shoot

Really, there are no 'official' subjects for digital IR photography. Sure, summer landscapes with leafy trees, lots of grass, and puffy clouds often make a great infrared picture. But don't be confined to basic landscapes.

Some of the artists profiled in this book like to shoot people in IR. Take a look at some of their portraits. I like to photograph cars, so I made this picture of two classic Jaguars.

I used the hyperfocal distance to insure sharp focus and set exposure compensation at plus 1-1/3 stops to make the whites sparkle. 1/16 second; f/16; ISO 200.

Any subject is fair game if you want to produce I images. As I keep advising, experiment to see what works. You may be surprised at the variety of subject matter you can find for IR photographs.





Photographs of people are often not considered when creating IR images, but Paul Nuber enjoys creating dreamlike infrared portraits. In reality, the woman's dress and fan are black but appear white here because the dye in the fabrics reflected infrared wavelengths. Olympus C2020Z and B+W 093 filter. 1/5 second: F/2.8; ISO 200. Photo ©Paul Nuber.

Profiles in Infrared: Paul Nuber

Paul Nuber of Fort Collins, Colorado is a part-time professional portrait photographer whose work includes shooting weddings, families, high-school seniors, and models (www.pozim.com). Most of his customers buy traditional portraits, but when shooting for his portfolio, Paul likes to experiment. "I tried B&W infrared film a few times, and liked the effect," he told me, "but it was hard to previsualize the results and difficult to expose correctly."

In 2000 Paul bought his first digital camera, an Olympus C2020Z. When he attached an IR filter and turned on the LCD display, things became clear: "I could see the world in infrared!" It was a quantum leap from film. Paul says, "I shoot infrared because it creates an image with recognizable shapes but unfamiliar tonality. Some parts of the image look normal, yet other parts don't. I enjoy the contrast of black sky and white foliage."



For this autumnal photo, Paul describes the setup as follows: "I selected this setting for the light leaves on the ground, the dark tree trunk, and the interesting sky, positioning myself about 45 degrees off axis with the sun. I asked the model to face the sun for best lighting. The sun is low in the sky, which reduces its brightness and allows it to light up her eyes. I try to shoot IR in direct sun, because it keeps exposure times short enough for the model to hold still, and it keeps the light foliage from going gray." 1/30 second; f/2.2, ISO 200. Photo ©Paul Nuber.

Infrared Filters

"I really believe there are things nobody would see if I didn't photograph them." Diane Arbus

Digital sensors are designed to imitate the response of our eyes to visible light, but infrared photography is about recording non-visible wavelengths. (Remember that the spectral range where red wavelengths are no longer visible starts at about 700 nm, give or take a few nm.) In order to record infrared photographs, those visible light wavelengths below 700 nm must be blocked so that they don't reach the sensor. Which brings us to filters. If you shoot with a digital camera that has not been converted to IR-only, you will need to use a filter to create infrared photos.

How Do Filters Work?

It is a misconception to think that a colored filter adds its color to an image. This is not the case. When used in traditional photography, colored filters transmit wavelengths that are a similar color to the filter and block ones that are not. For example, in traditional color photography, a blue filter that's used to color-correct photographs made under incandescent light does not actually add blue to the image. It subtracts the red and yellow tones, rendering the image more neutral in appearance. Depending on the density of the blue filter, it blocks more or less of these other colors. In much the same way, the various deep red (becoming almost black) filters used for infrared photography totally or partially absorb or subtract visible light while allowing the transmission of infrared light.

The information in this chapter is about using filters to produce monochrome or black-and-white IR images. (Black-and-white images are monochrome, but not all monochrome images, as you will see throughout this book, are black and white.) Images captured by all of the methods suggested in this book start as RGB (color) digital files and have to be processed to make them appear monochromatic. (Even when you use a camera's black-and-white mode, the sensor is still recording RGB information—the camera then has to process that image to make it black and white.) Creating IR color images is a "faux" process that requires creative postproduction techniques, covered in more detail in subsequent chapters of this book.

So what kind of filter do you need for your digital camera?



This infrared photo was shot using a conventional digital SLR equipped with a Hoya R72 filter. An exposure compensation of plus one stop was used after reviewing a test shot on the LCD screen. 1/8 second; f/5.1; ISO 100.

Filters for IR Photography

Filters have a long history of use in photography for both practical and creative purposes. In this guide, however, we are concerned with filters that specifically absorb or reflect visible light, allowing you to record the infrared spectrum. The classic IR filter is a round piece of glass within a metal or plastic mount that allows it to be threaded on the front of a lens. These are sold in various sizes to mount directly onto different sized lenses. A quality filter is made of fine optically flat material mounted within a frame that's strong, durable, and not prone to binding or cross threading. This takes precision manufacturing, which is why a good filter can be expensive (but will last a lifetime if well cared for).

Filters come in many different shapes, sizes, and materials, including delicate gelatin filters that drop into holders or lens hoods, round glass filters, and square or rectangular glass or optical-plastic ones that fit into modular holders.

The modular concept was popularized by Cokin, whose system includes a holder that attaches to the front of the lens with an adapter ring. The system's square filters slip into the holder. Though you may need different sized attachment rings to fit your various lenses, you won't have to buy a different IR filter for each lens because the same holder and filter can be used with different sized adapter rings. On the downside, since the filter is not physically threaded into the front of the lens like a screw-in type, visible light can also enter from the sides, polluting the finished image. Is this a good thing or a bad thing? Depending on your desired effect, it's a little of both.

Semi-Famous Filter Facts

Many filters have a number designation based on a system of tolerances first developed by Frederick Wratten, who pioneered the use of colored filters at the beginning of the 20th Century. His company, Wratten and Wainwright, made photo materials for the commercial printing industry. He had established his filter numbering system, the "Wratten system," by 1909 when he published *The Photography Of Coloured Objects*. In 1912, George Eastman acquired the company and Wratten's system became a standard for filters used in photography, astronomy, and other applications. Eastman Kodak Company still manufactures and markets KODAK Wratten Gelatin@ filters. Other filter manufacturers have their own designations, but they also often refer to the Wratten equivalent.

There is not a great deal of intuitive logic in the organizing system for Wratten numbers. Number 25 in the Wratten system is a red filter that passes visible red as well as infrared wavelengths to the film or sensor (thus blocking wavelengths shorter than 580 nm—remember that the wavelengths of visible light range from approximately 380 to 700 nm). You can easily see through a red #25.

Other filters that block all (or nearly all) visible light, from 700 nm and below, will be much darker than the Wratten #25. Depending on their specifications, these opaque filters are extremely difficult or impossible to see through.

If you happen to be shooting black-and-white IR with a red filter, you won't need to compensate for focus (to use the infrared focusing mark if it exists on your lens, or hyperfocal distance) because most of the light hitting the sensor is from the visible spectrum. This means the focusing distance is the same as it would be for an unfiltered photograph. All this changes when an opaque filter is used, because only infrared light reaches the imaging sensor, and a slight focusing adjustment needs to be made. If the lens doesn't have an infrared mark, Eastman Kodak Company recommends that you first focus through a KODAK Wratten Gelatin @ #25 filter using a small aperture, such as f/16 or f/22. Then switch to a darker filter because the depth-of-field at these small f/stops usually offsets the slight difference between the visual and infrared focus. (For more on focusing, see pages 30-35)



As I've mentioned elsewhere, you can sometimes get fooled about what kind of scene will make a good infrared picture. But this was a good candidate because of the trees, the grass, and the way the light was shining at that time of day. 1/1600 second; f/8; ISO 400.



Find out if your camera has a black-and-white shooting mode. It can help you learn what types of scenes work well as monochrome images. 1/2000 second; f/8; ISO 400. Minus 1/3 stop exposure compensation.

Now with the camera set in black-and-white mode, I used a Heliopan RC 1000, an opaque IR filter that blocks all wavelengths shorter than 880 nm. 10 seconds; f/8; ISO 400. Plus one-stop exposure compensation.



Cleaning Filters

When cleaning glass screw-mount filters, you should take as much care as when you clean your lenses. It's a good idea to use a microfiber cleaning cloth, but never chemical lens cleaning fluid, which might damage the coating. Filters manufactured with optical plastics require even more care because they scratch easier than glass.

Filters

Color	Approximate nm transmission 0%	50%	KODAK Gelatin Wratten	B+W	Co
Yellow/Orange	520 or shorter	540	#16	099	
Red	580 or shorter	600	#25	090	003
Dark Red	600 or shorter	620	#29	091	
Darker Red	645 or shorter	680	#70		
Extremely Dark Red	680 or shorter	720	#89B	092	007
Nearly opaque	700 or shorter	750	#88A		
Opaque: cuts all visible	720 or shorter	800	#87		
Opaque	790 or shorter	850	#87C	093	
Black	820 or shorter	930	#87B*		
Black	880 or shorter	1050	#87A*		
Black	**				

*No longer produced by Eastman Kodak

** transmits over 90% IR wavelengths between 700 and 1100 nm

Analyzing Transmission Rates and Filter Numbers

When trying to describe what an IR filter is actually doing, we often talk about transmission rates. As we've learned, a filter is designed to absorb or reflect certain wavelengths. For IR filters, we are concerned with blocking near infrared wavelengths and the shorter visible wavelengths.

If a filter (such as an 89B) has a 0% transmission rate at 680 nm, it is cutting out all wavelengths below that number, thus most of the visible spectrum. In general, filters don't suddenly turn on or off at a given wavelength, but block wavelengths at a progressive rate of change. This will vary from filter to filter. Therefore, the filter with 0% transmission of wavelengths of 680 nm might exhibit a 50% transmission of wavelengths of 720 nm, meaning that 50% of the radiation with a wavelength of 720 nm is transmitted (and 50% is not transmitted). Typically the rate of change rises quite sharply, so this particular filter may be transmitting 85-90% or more of radiation with wavelengths of 750-775 nm.

It would be nice if all filter manufacturers adopted a logical numbering system to identify their filters, but that is not the case. For example, a Hoya R72 starts to transmit wavelengths above 720 nm, but the company's RM90 transmits wavelengths above 820 nm. By contrast, the Wratten 89B, which is similar to a Cokin 007, allows wavelengths beginning at 680 nm to pass.

Heliopan	Hoya	Lee	Singh Ray	Tiffen
				16
1025 (RG 590)	25A	25		25
1029 (RG 630)				
5695 (RG 695)				
5715 (RG 715)				
5780 (RG 780)	R72	87		87
5830 (RG 830)		87C		
5850 (RG 850)	RM90			
5100 (RG 1000)	RM100			
			I-Ray	

Full range of Wavelengths
(in nanometers)

	From		To
Ultraviolet	4	(invisible)	380
Violet	380	(visible)	410
Indigo	410	(visible)	430
Blue	430	(visible)	520
Green	520	(visible)	560
Yellow	560	(visible)	580
Orange	580	(visible)	650
Red	650	(visible)	700
Infrared	700	(invisible)	10^5

All ranges are approximate; there is some overlap between colors.



The B&W 092 infrared filter is a dark, purplish red and blocks most of the visible spectrum, starting to transmit near infrared wavelengths of approximately 680 nm. Photo courtesy of Schneider Optics Inc.

A comparable filter is called 092 when manufactured by B+W. A Wratten 87 is the equivalent of a Heliopan 5780 (sometimes called am RG 780) and a Tiffen 87! See what I mean?

While this lack of a standardized numbering system can be a source of confusion, it is just the way that filters and lots of other stuff have been handled in photography, with each manufacturer creating a numbering system as they go (you'll need a Rosetta Stone to help you decipher it all).



Flare often appears in an image as a series of **light** circles that detracts from your subject and reduces sharpness and contrast. Sometimes you can use flare creatively by pointing your camera toward the light source.

Flare

Flare often takes the form of a streak or pattern of spots on your image. It can be a problem, particularly when shooting with a wide-angle or zoom lens, and it's exacerbated when using an IR filter. One of the most important accessories available when shooting digital IR images is a proper lens hood—one that is specifically designed for your lens. This will help reduce flare that is caused by strong external light sources.

To make things more challenging, digital cameras have to deal with more possibility of flare or ghosting than film cameras. Not only can flare and ghosting increase when lenses with flat-surfaced elements are used on digital cameras, but image sensor and internal filters are more reflective than film, creating additional reflections in a digital SLR's mirror box that result in lens flare. Strong flare can produce a blurred image that is clearly observable. And even slight flare reduces contrast, making it difficult to ascertain if an image is slightly out of focus.

However, there is only one hard and fast rule, which is: There are no rules. In defense of flare, I like to use it as a compositional element and sometimes deliberately point my lens so that the sun is in a corner of the frame, creating strings of reflections—especially with wide-angle zooms—stretching across the image. When digital purists see this they may pull out their hair in a Charlie Brown like ARRRRGGGGHHHHH! But if you like flare, as I do, don't let it bother you.

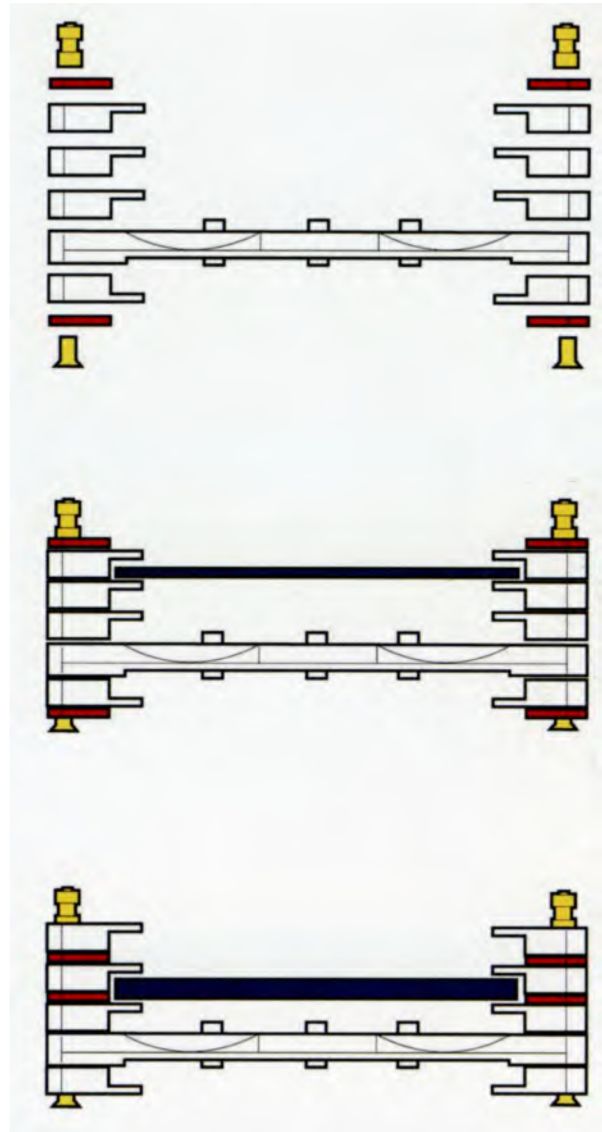
Filter Choices

Gelatin filters are made by dissolving organic dye in liquid gelatin, which is allowed to dry. The gelatin is then cut into square or rectangular shapes. **A** popular size is 3 x 3 inches (7.6 x 7.6 cm), although they're available up to 14 x 18 inches (36 x 46 cm). Since gel filters are only .1mm thick, they offer excellent optical quality, but they are fragile. You can tape gel filters to the front of a lens, but they'll last longer if you use them in holders designed for the task. Camera manufacturers such as Canon, Hasselblad, and Nikon make gel filter holders as well as accessory manufacturers such as Cokin, Kenko, and Lee. In the past, gel filters were inexpensive, but now you can expect **to** pay $25 or more depending on size and type.

Some glass filters are constructed by sandwiching a gelatin filter between two sheets of glass. Over time, these materials could separate, causing bubbling and peeling. An alternative is to dye the glass in a molten state, which also means there's no danger of color shifts as the filter ages. All polarizers are laminated because they use polarizing film to make the filter do what it's supposed to do—reduce reflections.

The most commonly used filters are glass mounted in threaded rings. How well a round filter's mounting ring is made should be obvious from just picking it up, twirling it around in your fingers, and screwing it onto a lens. Premium filter manufacturers such as Heliopan and B+W often use brass rings because the material tends not to bind or cross thread. Others use aluminum because it absorbs shock in the case of accidental impact.

Cokin currently markets four different sized modular filter systems, all of which include their infrared filter. These are the A series, the P, the X-PRO, and the Z-PRO. Each system is designed for the lenses of different formats. Similar modular filter systems are also available from Lindahl, Pro4 Imaging, Sailwind, and



The three-slot Cokin Z-Pro holder can hold filters of different thicknesses. Photo courtesy of Omega Satter.



When I planted this apple tree I didn't realize how convenient it would be for making IR test shots with new cameras and filters. This photo was made with an IR-converted digital SLR. 1/15 second; f/22; ISO 100.



Here a Singh-Ray I-Ray filter was used on the same IR-converted digital SLR. The exposure is identical to the first example. There is a slight difference in the image: The sky in the Singh-Ray filtered image is blacker and denser, and the white leaves are whiter.

others. These companies offer their own modular holder, but the filters themselves are usually compatible with Cokin's holders.

While Lee Filters, a division of Panavision, makes high-quality glass, resin, and polyester filters predominantly for the motion picture and television industry, many still photographers use their products. They offer a few polyester IR filters including an 87 and 87C, along with a Red number 25, in sizes from 75mm to 100mm square. There aren't any IR movies or TV shows out there, at least not yet.

Tiffen manufactures both screw-in filters and those that fit modular holders.

Singh Ray is known for high-quality specialized filters. They make filters that fit modular holders, such as Cokin, as well as the ring-mounted I-Ray filter that blocks nearly all visible light, resulting in some purely dreamlike images.

Standing on Three Legs

Why is a tripod absolutely necessary if you plan to shoot IR using a conventional digital camera with IR filters? Well, there are a couple of reasons. First, with an unconverted camera, the IIRC (that hasn't been removed) reduces the amount of IR wavelengths reaching the sensor. Second, remember that you need to stop down in order to take advantage of the depth of field necessary to insure that IR photos are acceptably sharp. Smaller f/stops further reduce the amount of light that can reach your sensor. To compensate for these circumstances, you will have to increase exposure time, making the use of a tripod or other form of camera support essential.

A quality tripod is an investment that is sure to improve your photography. It should be sturdy but lightweight enough so that you'll take it with you. Otherwise a tripod does you no good whatsoever. In addition, using a tripod enforces a deliberate approach to making photographs. Having to think about composition before banging off a few frames will improve the quality of your images more than you might imagine.



This conventional color photo is used as a reference for the IR images on this page. The camera was mounted on a tripod. 1/125 second; f/22; ISO 400.



With a Singh-Ray I-Ray filter attached to my lens, I switched to Manual exposure to set a longer shutter speed at the same aperture. This image was difficult to evaluate because of glare on the LCD screen, so I enhanced it in the computer. 6 seconds; f/22; ISO 400.



This image was created using the in-camera sepia mode. Adjusting the shutter speed from 6 to 4 seconds helped decrease the exposure. 4 seconds; f/22; ISO 400.

Different Filters Give Different Effects

This series of photos illustrates the results of experimenting with different filters. The pictures will give you an idea of what happens when you place different filters in front of your lens.



The non-IR color image was shot using a digital SLR. 1/500 second; f/9; ISO 400.



B+W's 090 red filter is equivalent to the number 25 in the Wratten system. It is also useful for enhancing contrast in digital black and white and can give great tonal results when shooting landscapes. The 090 filter does not create a fully IR photo because it blocks all wavelengths below 580nm, but allows some visible light wavelengths to pass. 1/100 second; f/4.0; ISO 400.

Premium IR Filters

Alas, it often seems that there is no middle ground in IR filters. As soon as you move past the initial consumer-level choices, the price curve rises pretty quickly. This is largely a result of the way these premium quality filters are manufactured.

Consumer-level filters are generally produced in much larger quantities and seem to be built to a price point (so the average photographer like you and me can afford them), while manufacturers of premium brands claim higher labor costs because they use skilled employees and build to tighter tolerances.

These no-compromise filters are not just for fooling around with IR photography, more often than not they are used for professional, scientific, and technical applications, which necessitates stricter standards and quality control. This includes: high-quality, optically flat glass or resin that is ground, polished, and coated to the strictest tolerances of the optical industry and high consistency from batch to batch. Premium screw-in filters are mounted in anodized brass rings to reduce binding or cross threading and to ensure optimal alignment. These high-end filters also tend to be offered in a wider array of sizes and types, including bayonet mounts for use with Rollei and Hasselblad. This extra expense is probably absorbed to a degree by the pricing of the more popular filter sizes and types.



A B&W 092 IR file created a relatively mild effect in this picture. Why is it so subtle? I don't know for sure. Sometimes the result depends on how the filter relates to the inherent IR sensitivity of the camera's sensor. 3.2 seconds; f/22; ISO 400.

The B+W 093 filters out the entire visible spectrum and transmits over 95% of wavelengths longer than 900 nm. Though filters like this can create a strong IR photo, hot spots like the one on the right sometimes appear when infrared reflectivity is high. These kinds of "blooms" are not always visible on the camera's LCD review screen, which is why it is always a good idea to bracket exposure. 10 seconds; f/22; ISO 400.



Many early Konica Minolta digital cameras are infrared sensitive, so I decided to test how responsive a DiMage point-and-shoot model **is to IR** radiation. With the camera mounted on a tripod, **I** shot this photo using black-and-white mode. 1/1000 second; f/3.3; ISO 100.

Using Filters with Non-SLR Digital Cameras

What if you don't currently own a digital SLR? Can you use IR filters with the popular small digital cameras that usually don't have threaded lenses for accepting filters? Sure, why not?

Some camera manufacturers, including Leica, Samsung, Sony, and Toshiba, offer adapters to allow filters to be used on their digital zoom cameras. Plus there are lots of filter adapters made by accessory manufacturers. For example, PictureLine makes an extensive line of adapters for Canon point-and-shoot digital cameras. Don't overlook one of the greatest sources of photo gadgets the world has ever known—Porter's Camera Store. They offer adapters for Canon, Konica Minolta, Olympus, and Sony digital cameras.

Also, Cokin makes a Digi-Shoe Holder that attaches to the camera via the tripod socket and accepts their A-series filters. If you don't have a tripod socket, don't worry. They also produce the Digi-Magnetic Holder that works with most small cameras. However, for best results, the caveat remains that



Next I held an I-Ray infrared filter in front of the lens. The camera is still on a tripod. The exposure for IR was relatively long. I'll show you how to add the sepia tone to your black and white IR images in an upcoming chapter. 2 seconds; f/3.3; ISO 160.

there should be as little space as possible between the filter and the lens. Whatever holder you are thinking of buying, try it out in your friendly neighborhood camera store before plunking down the twenty bucks it costs.



This is an example of the surreal look that Chip Talbert likes to create. He was struck by the juxtaposition of the unusual artwork in the foreground with the ordinary buildings in the back. This almost looks like an alien landscape. 1/60 second; f/2; ISO 100. Photo © Chip Talbert.

Profiles in Infrared: Chip Talbert

Chip Talbert is a web designer from Chattanooga, Tennessee whose interest in photography turned into a passion when digital photography became a reality. His interest in digital infrared developed through the practical need to take appealing pictures at midday in bright sunlight—the worst time of day for visible light photography. Chip quickly discovered the surreal aspects of digital IR landscape and architectural photography and decided to explore this new application further.

Chip's website (www.chiptalbert.com) showcases his photography and skills as a web designer. His IR images are warm-toned, exhibiting classical composition with technical brilliance. Chip Talbert is clearly a guy who is passionate about IR photography, and it shows.

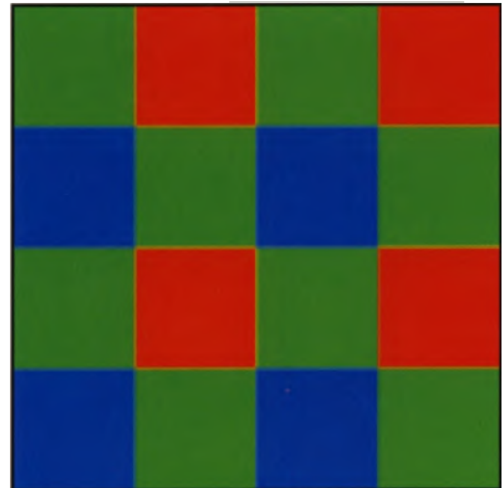


This image was again shot using a Hoya R72, and was later toned using software. 1/60 second; f/2; **ISO 100. Photo © Chip Talbert.**

Creating Digital IR Images

"There's more to the picture than meets the eye." Neil Young

Your camera is in hand, ready to shoot. You know what wavelengths you want to record, and you understand the focus and exposure challenges posed by IR photography. Now let's look at creating digital IR files.



Light is captured by a camera sensor based on its intensity, not its color. This Bayer pattern is an example of a color filter array that allows the camera to interpolate color from this sensor data. The filter pattern alternates green and blue in one row and green and red in the next. The extra green filters allow the processed color file to better resemble human vision.

Imaging Sensors

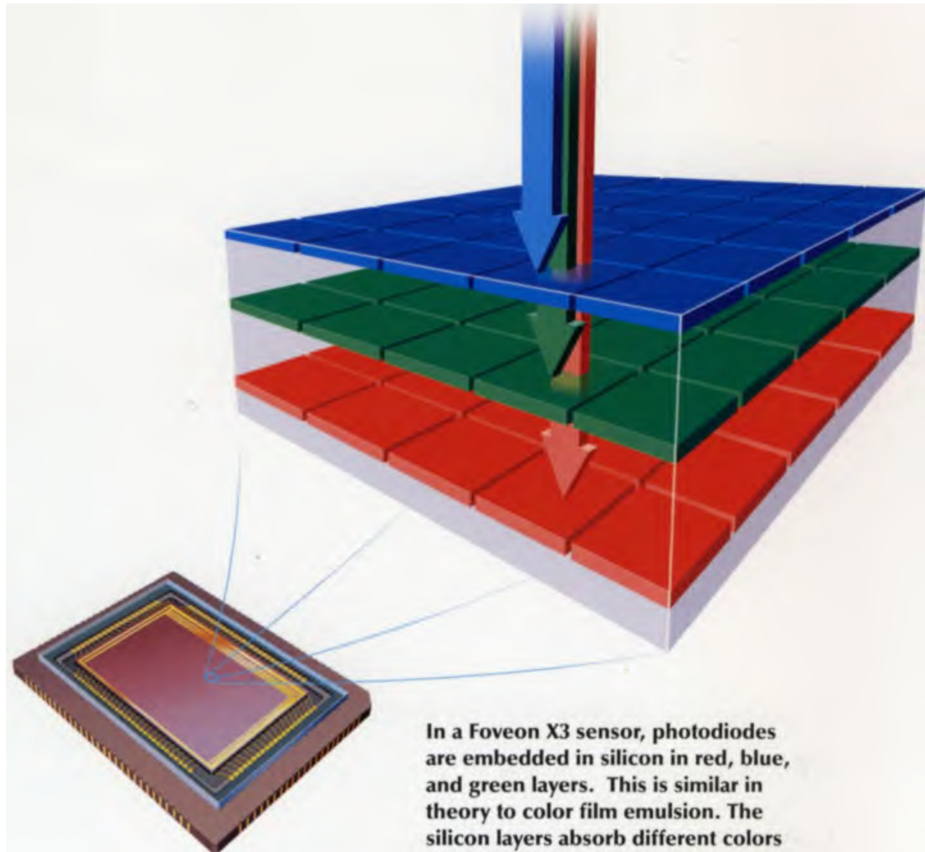
Here's a fact you may not know: The imaging sensor in your camera records only in black and white. Let that sink in a minute. Each pixel on a digital camera's imaging chip contains a light-sensitive photodiode that converts light to electrical current in proportion to the quantity of light that falls on it. Photodiodes can't tell the difference between different wavelengths of light, they only react to intensity. The typical way to add color to the digital image is to apply a color filter mosaic, using a red-green-blue pattern.

There are several ways to do this, but the most common is a filter arranged in what is called a Bayer pattern, which looks like a mosaic of red, green, and blue squares. Half of the total number of pixels is filtered with green (G), while a quarter of the total is filtered with red (R), and the other quarter with blue (B), in a repeating 2x2 arrangement. Rows of color in a sequence of GRGRGR (etc.) alternate with a sequence of BGBGBG. That's why this output is called sequential RGB (or sRGB). The camera's processor actually uses the information from the Bayer pattern to interpolate the color of all of the pixels.

Sensor Choices

In its professional level digital SLR, Fuji uses a Super CCD SR II chip that has two kinds of photo diodes—shadow (S) and highlight (R). The larger S diodes respond to low light, recording shadow detail, while the R diodes capture highlights at lower sensitivity to retain detail. Fuji claims that this effectively expands the dynamic range beyond what can be achieved with conventional CCDs.

In addition to CCD sensors, there are other types used in digital cameras. These include CMOS and Foveon sensors, as illustrated here.



In a Foveon X3 sensor, photodiodes are embedded in silicon in red, blue, and green layers. This is similar in theory to color film emulsion. The silicon layers absorb different colors at different depths, thus forming the full-color image. Image courtesy of Foveon, Inc.



This is the CMOS (Complementary Metal Oxide Semiconductor) imaging sensor used in Canon's EOS Digital Rebel XT. You can't see the pixels or the RGB filters arranged in a Bayer pattern, but they're in there. Image courtesy of Canon USA.

Recording the Image

I prefer to create digital IR images using the camera's built-in black-and-white mode. (We'll shortly consider what to do if your camera does not have a mode for recording black and white). When using the black-and-white mode, you can visually review the black-and-white image on your camera's LCD screen to see if the exposure came close to creating the infrared image you wanted. This is helpful, but even so, the LCD screen may display different brightness and contrast than the actual image, especially with infrared images. You can tell more about your exposure if your camera has a histogram function. The bottom line is this: No matter how close you get to recording your desired image, there is nearly always room for a few simple image-processing steps to tweak that less-than-perfect image in the computer to make it live up to your infrared expectations.

Tweaking Black-and-White Images in Image Processing

I believe in using the minimal amount of tweaking necessary to produce that final image. If you work with JPEG files, JPEG compression artifacts will occur every time you reopen them to apply additional enhancements and then save again. However tiny, these artifacts contribute to reduced image quality. They may not matter if you have a large file that you consider a mere snapshot. But you never know when you will produce your personal digital equivalent of Ansel Adam's "Moonrise, Hernandez, New Mexico," so it's a good idea to start practicing skillful digital darkroom habits now, including the habit of saving your duplicate work-files as TIFFs, which will not introduce artifacts as you continue to open and re-save these files.



Step 1: Open the original infrared image file (above) in your image-processing software and make a duplicate for processing (Image > Duplicate). Remember to save your duplicate as a TIFF file.

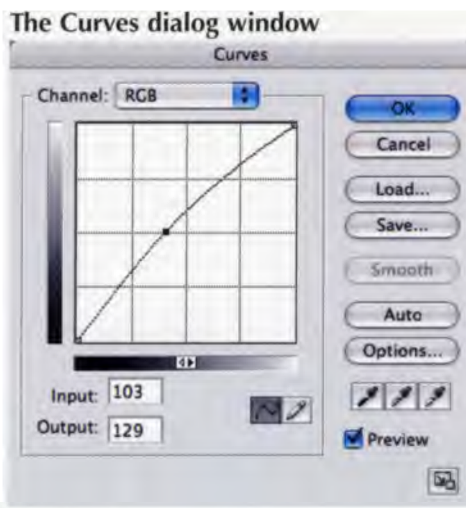
Step 2: Open the Levels option (Image > Adjustments > Levels) to reveal a histogram of your image file. The data in the histogram for the photo above ends well before reaching the right axis, signifying that the image is underexposed, a conclusion also confirmed by observing the picture. You can improve the distribution of image tones by adjusting the histogram.

Step 3: the Levels dialog box, drag the small white triangle on the right axis until it reaches the last point on the graph that shows data. This will add highlight tones to the image. Similarly, move the small black triangle from the left axis to the right until it reaches the point indicating data. This will add rich darks instead of leaving shadows flat.



The image above now looks more properly exposed, but it can use additional enhancement. The whites in the trees still aren't as bright as I would like to see them.

The Curves dialog window



Step 4: Open the Curves option (Image > Adjustment > Curves) to make even more subtle and precise adjustments to the tonal range of the image file.



Step 5: Click the middle of the Curves diagonal and drag up to lighten the image. Conversely, click and drag down to darken the image. As a result of using Curves, the whites are brighter (see above). But the overall image looks flat to me—lacking contrast.

The Brightness/Contrast dialog window



Step 6: the Brightness/Contrast option (Adjustments > Brightness/Contrast) and add a dash o' contrast by dragging the Contrast slider to the right. Because dark areas tend to recede and light ones seem to come forward, this enhanced the perception of depth in the photo.

I moved the Contrast slider up to 14 for this illustration, but there are no "magic numbers." Just season to taste, as Emeril would say. If you click the preview box (check), you can see the effect of the contrast adjustment as you apply them to your image.

Step 7: Compare the original to this adjusted copy (below). To finalize the image processing, I applied a bit of selective burning (darkening) and dodging (lightening). You can try additional experiments; just know when to quit. I have a "20-minute rule." If the image doesn't look the way I want within twenty minutes, it never will.



From Digital Color IR to Digital B&W IR

If you camera doesn't have a black-and-white mode, you have no choice but to shoot in color and convert that image into black and white using your computer's image-processing program.

When you shoot IR in color, your sensor will interpret the data as a "color" file, even with filters that block or absorb the color spectrum. So depending on the camera, the filtration, and the IR reflectance of the scene, the camera will generate an image that usually exhibits a blue or magenta cast.

Here are some quick and easy ways to turn that glorious magenta image into something a little more dramatic.

One of the easiest and simplest methods to create a black-and-white image from the blue or magenta digital IR file is to use the monochrome option usually found in most image-processing programs under the Mode menu.



Here is the original color image file that I downloaded from my converted digial SLR. 1/200 second; f/16; ISO 400.

Step 1: Make a duplicate TIFF of your blue or magenta IR digital file and select the monochrome or grayscale option in your image-processing software (Image > Mode > Grayscale).



Step 2: Convert the image from color to black and white by eliminating the color information. In Adobe Photoshop, you can do this by changing the Mode to Grayscale. When you do so, this dialog box will appear asking if it's OK to discard the color information. Click OK and remove the color.



Step 3: up the contrast a bit, especially if the new monochrome file looks flat (a condition that indicates a lack of contrast!). The simplest way to correct this is to use the Brightness/Contrast control (Image > Adjustments > Brightness/Contrast). Gradually move the Contrast slider (a positive number indicates an increase in contrast) and observe the effect until you are satisfied, then click OK.

The finished image with only two tweaks: The first to remove all color and the second to increase contrast slightly. That may be all you need to do, but if you want to try additional methods for changing from color to black and white, keep reading.

I shot this image with the Fuji S20 Pro's color mode and a Hoya R72 IR filter. 1/6 second, f/2.8, ISO 400.

Mixing Color Channel

Many image-processing programs offer an option to produce grayscale images by letting you choose the percentage contribution from each color channel (R, G, or B). This control modifies a targeted output, in this case grayscale, using a mix of the existing image's color channels. A channel mixing application adds or subtracts data from a source channel to the output channel (Gray, when the Monochrome box is checked). This takes a little more work than the previous example, but with practice you can whip through it.

Channel Mixer dialog window



After opening a duplicate image file, open the channel mixer option (Image > Adjustments > Channel Mixer). Be sure to check the Monochrome box to set Gray as the output channel.



The finished black-and-white IR photograph.

Checking the Monochrome option in the Channel Mixer dialog box will create an image that contains only gray values. Move the sliders to control the amount of detail and contrast in the image you plan to convert to grayscale. But first make sure the Preview box is checked so you can view how changes in each source channel affect the monochrome image. When adjusting the percentages of the source channels, you often get the best results when the combined values of the source channels add up to 100%. If you go over 100%, you'll overexpose an image. On the other hand, if you go under 100%, you will underexpose an image.

As is often the case in the world of digital IR photography, there is more than one way to accomplish your goals. Mixing channels is a popular method to convert color IR images to grayscale, but there are others, including plug-ins. These alternatives, while offering less control than mixing color channels, take fewer steps and are faster. That's why I say they are such powerful tools.


Open the image file in your image-processing program and create a duplicate TIFF for processing. This original color image was shot with a Fuji S20 Pro camera with a Hoya R72 IR filter. 1/6 second, f/2.9, ISO 400.

Plug-ins: Powerful Black-and-White Conversion Tools

Add speed to IR conversions by utilizing additional software programs that make it easier to create practicular special effects. These programs are known as plug-ins, and they operate in tandem with your image-processing program. In the same way that an electric screwdriver makes household projects faster than using an old-fashioned hand tool, these powerful software tools let you produce imaging projects quicker and with less fuss than making your way through a number of menu steps.

There are plug-ins available from many different producers that perform all types of effects, and more are coming out all the time. There is no way we can examine all of the pertinent filters available, but examples of many of the leading products are included in the following chapters.

Among the many filters found in plug-ins that work really well to convert your IR photos to black-and-white, those in Nik Software's Nik Color Efex product adapt their effects based on the colors and contrast range of each image. The complete edition of Color Efex Pro 2.0 includes three black-and-white conversion filters (the most basic B/W Conversion; B/W Conversion: Tonal Enhancer with additional contrast enhancements; and B/W Conversion Dynamic Contrast). These transform a color image into black

and white while allowing you to manage the highlights, shadows, and relationship of the original colors by using controls for color spectrum, brightness, and contrast. While all three filters are effective, I like the B/W Conversion: Dynamic Contrast option because it contains a Contrast Enhancer that creates an exaggerated dynamic range within the image.



As a plug-in, Nik Software's Nik Color Efex Pro 2.0 operates as part of your image-processing program (in this case, Adobe Photoshop CS2). The filters in this plug-in are applied to all previous filter processing changes you have made to the image.

For the final image, I only had to move a few sliders in the plug-in's dialog window to produce an excellent IR digital photograph.



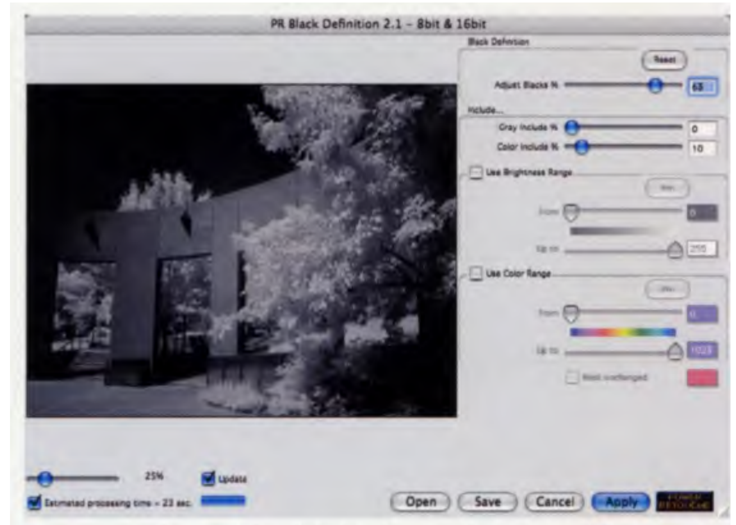
This original color image was created with a digital SLR that was converted for IR photography. 1/80 second, f/16, ISO 400.

Everybody has their preferred black-and-white conversion methods, but my current favorite (and maybe the best monochrome plug-in ever) is Black & White Studio from Power Retouche. This sophisticated program uses the light sensitivity of such films as Kodak Tri-X and T-MAX to make the conversion, or lets you create your own sensitivity curves and save them for later use. This plug-in is compatible with a number of host applications.

Power Retouche's Black Definition plug-in is a fine complement to Black & White Studio. It lets you adjust black as if it were a color channel. You can also find filter plug-ins that add Sepia, Van Dyck, Kallitype, Silver Gelatin, Platinum, Cyanotype, and other tones to your images.



A duplicate TIFF of the original IR color image file was converted to black and white using Black & White Studio. A green digital filter, part of this plug-in, was applied to heighten the IR effect (this will lighten the "greens" based on the plug-in's preset of generic "panchromatic" film emulation). Feel free to experiment with different presets and slider values to see what looks best to you—you can always cancel any effects you don't like.



Like most denizens of the digital darkroom, I'm never satisfied. In this case, I decided to try to add more snap to the image file. This is an example of Power Retouche's Black Definition plug-in, which lets you adjust black and can add extra "pop" to your photo.

Here's the finished IR photograph alter processing through two of Power Retouche's plug-ins for monochrome conversions and enhancement. Could I have toned the final image? Yes, and all of those tips, tricks, and techniques will be covered in a forthcoming chapter.



"Inlet Reflections." Carl was attracted to this IR scene because the willows along the bank gave off a pronounced white glow from the warmth of the setting sun. This panorama, stitched from three overlapping frames, was tweaked with Levels and Curve adjustments and some highlight dodging. Photographed with a Hoya R72 filter; 1 second; f/7.4; ISO 80. Photo © Carl Schofield.

Profiles In Infrared: Carl Schofield

Carl Schofield worked as a research scientist with the Department of Natural Resources from 1960 to 1995 at Cornell University where much of his work focused on the impact of acid rain. His long-term interest in nature and landscape photography dates back to his teen-age years.

Carl describes why he developed a passion for infrared photography: "Beyond red lies the surreal world of near infrared. Invisible to the unaided human eye, but capable of transforming the monotonous green landscape of summer into an ethereal, wintry-white dreamscape where luminous white clouds appear to float in the darkness of deep space and ghost-like images of trees reflect off inky black waters. Capturing images of this unworldly beauty that surrounds us was a moving, almost spiritual experience for me."

You can see Carl's IR landscapes on his website at www.schophoto.com.



"Market Benches" was photographed at the Farmers Market in Ithaca, NY approximately a half hour before sunset. The finished print was created by combining four overlapping frames. The exposure was 1/24 second at f/2.6. A Hoya R72 filter was used to block visible light. Photo © Carl Schofield.

Digital IR Image Processing



The last chapter demonstrated some of the software processing that can be used to tweak black-and-white IR images or convert color IR files to grayscale. Once you've recorded a digital IR image to your memory card, you will want to use computer software to complete the process of creating an IR photograph. It is possible to send the image files from the camera directly to a photofinisher for prints, but there is so much more you can do yourself to enhance your IR images and control the final output. And if you want to convert non-IR images to look like infrared photos, image-processing software is a necessity. For a lot of people, the digital darkroom is a fun part of infrared photography.

Choosing the right software can be confusing. There are many different products available, from entry-level programs that offer only a few image-enhancement options to professional-level packages that are extremely sophisticated and powerful. These programs also vary greatly in price, ranging from free downloads to (relatively) inexpensive packages to those costing hundreds of dollars.

"Always, always work with a copy of the original file."
Farace's Laws of the Computing Universe



This old Pontiac hood ornament was photographed using a Nikon digital SLR with a Wratten #87 filter. The far-out colors **in** this image are a result of image processing with Adobe Photoshop's Solarize filter. Photo ©Aaron Cathcart.

Scanning: Converting Your Existing IR Film library

You'll need a scanner if you want to digitize existing IR film negatives and photographs in your photo library. There are two big myths about making great scans: The first is that the process is so difficult that it is beyond the capabilities of the average person. The second is that it's really easy to make a great scan. Of the two, the second is truer than the first. The real secret is to examine all of the scanner software's options and make decisions appropriate for your output.

For many photographers, a flatbed scanner may be the best solution for converting prints, but if you have negatives and transparencies, you might investigate using a film or slide scanner or have them scanned by a lab.

The typical slide scanner has a slot in the front panel for inserting a slide or a strip of negatives. When the scanner starts working, it grabs the slide and pulls it inside during the scanning process. The features to look for in a film scanner are similar to those you want in a flatbed scanner, but you also should know which film formats it can digitize. If you only shoot 35mm film, you don't need to spend more money for a larger, more expensive scanner that can handle 4 x 5-inch sheet film.

Some scanners can scan prints, negatives, or slides. Before deciding on a specific scanner, you will want to research the different types to see what will best meet your particular needs.

When scanning IR film or prints, you have the choice of processing the image after you've downloaded the digitized file, or applying certain processing before scanning by using third-party acquisition software such as SilverFast from LaserSoft International. SilverFast's Prescan feature lets you freely rotate and resize the image before it's acquired. Its ScanPilot option automatically guides you step-by-step through the process of making individual image corrections. All operations are done in real time allowing you to see the effect of any changes you make, and unwanted modifications can be undone.



This house was photographed on black-and-white infrared negative film. The negative was scanned and converted to a positive using Photoshop's Invert command (Image > Adjustments > Invert).



I shot this photo using Kodak's old E-4 process with Ektachrome color infrared film almost 30 years ago, but was able to use a film scanner to digitize the image and bring it into the twenty-first century.

Let's face it, Adobe Photoshop is the 800-pound gorilla of image-processing programs. Do you need the "real thing" or one of the other image-processing programs on the market? Though most of the illustrations in this book were created with Photoshop CS2, that doesn't mean you can't use some other program. There are numerous choices, including such packages as Paint Shop Pro from Corel, PhotoImpact from Ulead, Photosop Elements from Adobe, and Picasa from Google. This is far from an exhaustive list, and sorting out which one is right for you is a matter of examining the different programs and analyzing your needs.

How are you going to use the software? It helps to start with a checklist to define your objectives. Your long-term goals may be different than your short term ones. When it comes to software, by the time you've gained enough experience to thoroughly make use of all the features in a program, superior new products may have been introduced. So, focus on your short-term goals. Do you want to create images for the web or for sharing family snapshots via email? Do you want to order framed enlargements to give as gifts? Or perhaps your interest lies in printing your own fine art and IR photographs to sell at art shows and galleries? Maybe you need to provide professional clients with press-ready images? Determine your needs and budget constraints, then research the different image-processing alternatives to find the best match for you.

The Layers Function

No matter what program you choose for digital IR processing, one of the most helpful features is Layers. That's because pictures in image-processing programs can be composed of many facets. Think of the paper used for printing in a conventional darkroom. Layers are like additional emulsions on the surface of that paper that allow you to create effects without interfering with what is on the other coatings. The Layers option is a powerful tool that lets you add drama and dimension in images, and can be found in other professional processing programs as well as Adobe Photoshop.

Another way to understand Layers is to imagine an image that is comprised of stacked sheets of clear acetate. Any part of the whole image—text or graphics, can be placed on a separate sheet anywhere within these layers of acetate. In places where there is no image on a layer, you will see through it to the layers below. At the bottom of the stack is a background layer. The advantage of using a program's Layer function is the ability to adjust or change a portion of the completed image without affecting the other parts. This can be as simple as adjusting color or can include more complex enhancements, such as the addition of a drop shadow.

The Layers Palette

One of the tools in Adobe Photoshop that helps you work and navigate within Layers is the Layers Palette. It features a visible display of all of the layers in an image, starting from the topmost to the background. The Layers Palette is used to create, hide, display, copy, merge, or delete layers from a document.

You can create new image layers by using the New Layer button at the bottom of the Layers Palette, or by choosing the New command from the Layer pull-down menu (Layer > New). In addition, a new layer will automatically be created if you drag and paste selections into your image. You can also copy layers between two open Photoshop images.

Adjustment Layers

In addition to basic image layers, there are a couple types of layers that serve different purposes. These are Fill Layers, which allow you to place colors, gradients, or patterns within a layer, and Adjustment Layers.

An Adjustment Layer is a powerful option in the Layer arsenal. It allows you to apply tonal and color corrections to any or all of the layers underneath it. These have the same Opacity and Mode options as Image Layers. By default, Adjustment Layers have Layer Masks that are indicated by the mask icon (white rectangle) to the right of the layer thumbnail. A Layer Mask is like a veil on top of a layer that lets you hide (or show) and edit selected portions of the layer. You are able to look at different combinations of these edits to see how the layers react with one another. When you achieve the desired result on-screen, you can merge the adjusted layers.

Photoshop's Adjustment Layers feature lets you perform color adjustments without affecting the original image data, allowing you to experiment with different adjustments, such as Levels, Curves, Hue/Saturation, Brightness/Contrast, Color Balance, and other options. Adjustment Layers can be hidden or discarded at any time, or moved up and down in the Layers Palette.

This gives you an added dimension of flexibility over normal Image Layers. Since an Adjustment Layer affects all layers that are below it in the Layers Palette, it allows you to make a single adjustment for an effect on multiple layers. And since an Adjustment Layer is not making permanent changes to the underlying image pixels, it can be modified any number of times without degrading image quality, which permits you to tweak settings and apply several different variations of effects that you can swap and/or turn off as desired. For example, you can create a Levels Adjustment Layer and use it to temporarily change the distribution of tones in your image, and then go back to readjust Levels at any time during processing by going to the Layers Palette and double-clicking the icon for the Levels Adjustment Layer. You can do the same with any of the other kinds of Adjustment Layers you create for your image file.

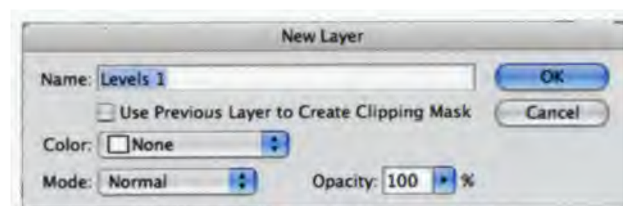
The following options can be managed in an Adjustment Layer:

- Color (as a Fill Layer)
- Pattern (ditto)
- Levels, Curves, Color Balance, Brightness/Contrast, Hue/Saturation
- Channel Mixer
- Selective Color
- Gradient Map
- Photo Filter (for Photoshop CS and later)
- Invert, Threshold, and Posterize.

This black-and-white infrared picture came right out of my converted Canon EOS digital SLR. It looks pretty nice, but we can have some fun using Adjustment Layers to change the look of this photo. 1/50 second; f/16; ISO 400.

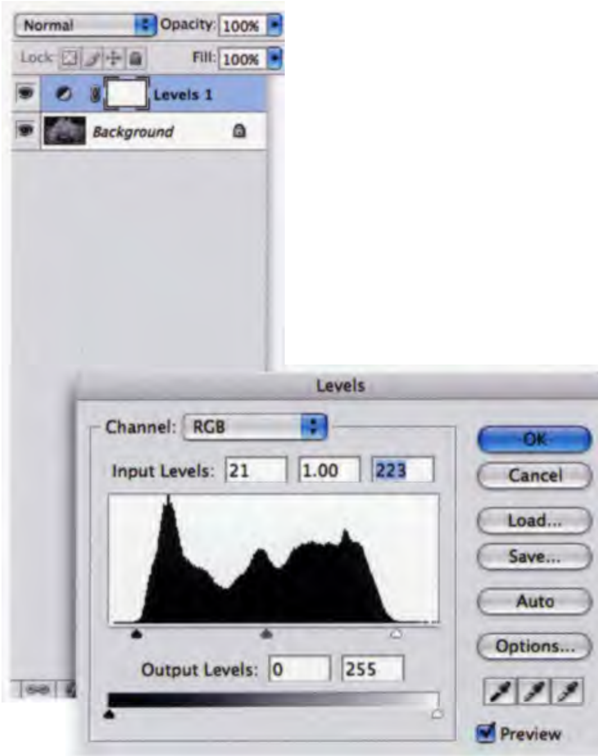
Creating Your Own Adjustment Layers

Step 1: As always, open an image and make a duplicate. If you only want to edit a section of the image, you can select the appropriate portion using any of Photoshop's selection tools.



The New Layer window for creating a Levels Adjustment layer.

Step 2: Go to Photoshop's Layer pull-down menu and select New Adjustment Layer. You will then have a choice between different types of Adjustment Layers. In this example, a Levels Adjustment Layer is selected, which opens a window to create and name a new layer.



The Levels dialog window with histogram allows you to adjust the **brightness and contrast of your image.**



The Photo Filter Adjustment layer simulates the use of a filter placed in front of your lens. Among other things, it adjusts color balance, white balance, or hue of your picture.

Step 3: Click OK in the New Layer window for Levels and a histogram appears. You can use the sliders under the graph to adjust the intensity of shadows, midtones, and highlights. When you are satisfied with your Levels adjustments, apply by clicking OK again. You can tweak this image as many times as you wish throughout the processing by double-clicking the icon for this Adjustment Layer in the Layers Palette and moving the sliders to different positions.

Step 4: You can quit here or add more layers. Another type of Adjustment layer is called Photo Filter. Its dialog window contains a number of filter effects as well as the option to choose custom colors from the color picker. Just for fun, let's add a Sepia tone from the Filters pull-down menu. The Density slider lets you apply the filter in exactly the strength you prefer.



Step 5: The final **IR** image was created using two Adjustment Layers. First, brightness and contrast were adjusted using a Levels layer. Then a sepia tone was applied using a Photo Filter layer. When you are sure you are done processing, flatten the image if you want to print (Layer > Flatten Image). This also decreases the file size, using less memory.

Popular IR Image Effects

There are a number of ways to use Layers and other digital tools to enhance your IR images. Your program will contain a number of processing choices, and you can get additional pieces of software such as plug-ins and Actions (more about Actions later in this chapter) to apply many types of practical and cool effects. (Remember that we took a look at black-and-white conversion plug-ins in the last chapter, but those programs have a wide variety of uses in the digital darkroom and can be used for additional effects, some of which are described in the following sections.)



Above, multiple image files were stitched together to produce a panorama that was desaturated and then tinted using a Hue/Saturation Adjustm layer in Adobe Photoshop. The photos were shot using a Canon PowerShot camera was with a Hoya R72 filter. Photo © Reggie Linsao.



Toning

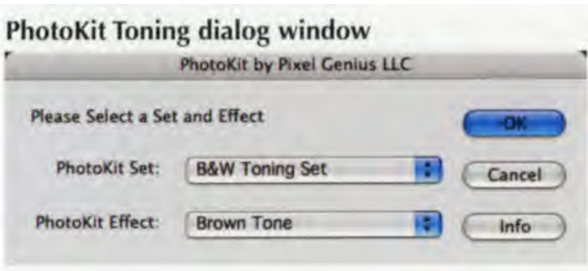
Toning is one way to give your IR images a little color. In the traditional darkroom, toning is a chemical process used to modify the color of black-and-white photographic prints. Different toners produce different colors in the final traditional print, and you can even choose to tone some parts of a print more than others.

A fun way to use Layers for infrared photographs is to reproduce a classic darkroom technique in which different toners are applied to different parts of the image. This is called split toning. It can be a messy and tedious procedure in the darkroom, but with image-processing software, it's a snap. Let me show you what I mean.

You can quickly turn this monochrome IR image into an interesting split tone picture in just a few steps by using a couple different plug-ins with your image-processing program.



Step 1: Dpen the original photograph and create a duplicate file for processing. The duplicate becomes your Background layer.



Step 2: Make your first choice about split toning. This example shows a Brown Tone layer added to the Background layer using a plug-in called PhotoKit from Pixel Genius. Using the Eraser tool, erase everything on the Brown Tone layer except the farmhouse and silo. This leaves just the silo and farmhouse from the Brown Tone layer on top of the grayscale photograph.

Step 3!Select the Background layer in the Layers Palette and create a duplicate of it (Layer > Duplicate Layer).



Step 4: Using PowerRetouche's Toned Photos Photoshop-compatible plug-in, tone the new layer as a Cyanotype (which is a blue traditional process). The Toned Photos filter plug-in offers a number of choices that mimic the appearance of old photographic process or toners, including the Cyanotype used here, as well as Sepia, Silver Gelatin, Platinum, Kallitype, Palladium, and Silver, among others.



Step 5: Perhaps the blue is too blue for your taste. You can always lower the Cyanotype layer's opacity using the Opacity Setting in the upper right corner of the Layers Palette. This will adjust the effect that the toner has on the image by letting more of the grayscale image show through to soften the look.

Step 6: We're Done! The final image consists of three layers, including a grayscale background, sepia buildings, and a blue tone underlay to create a split tone image without any muss or fuss. This is a fun and relatively painless way to create sophisticated images that you may want to print and frame.



If One Tone is Good, Why Not More?

A duotone is a form of printing that uses two colors of ink, one of which is often black. Duotones were developed in the printing process as a method of expanding a grayscale image's tonal range, allowing reproduction of subtle colors.

In Photoshop, you can use more than 150 preset duotones, tritones (black ink and two other colors), and quadtones (black ink and three other colors). When working with an RGB image, you must first convert it to 8-bit Grayscale (Image > Mode > 8-Bits/Channel; Image > Mode > Grayscale) before you get to the Duotone menu. (Image > Mode > Duotone.)

Make a selection in the dialog window from the Duotone, Tritone, or Quadtone menu, then pick the specific colors to make up your new image.

I drive by this house every day and **hardly ever** notice it, but in IR it's a whole new ball game. Even though it was a cloudy day, there was enough IR being reflected to create this successful study. As nice as this photo is, it might look even better as a duotone, so lets give it a try.



Once you open the Duotone dialog window, you can load different presets by clicking on the Load button in the window and then selecting a specific color from a standard dialog box that appears.



In Adobe Photoshop, you will find the Duotone presets in the "Duotones" folder that is stored inside the "Presets" folder.



Here is the image processed as a Mauve duotone. At this point I usually convert the file back to RGB (Image > Mode > RGB Color) to save it (the color will not be affected). If you leave as a Grayscale Duotone, fewer of Photoshop's tools will be available for tweaking later. In this case, I brightened the white a bit using the Levels (Image > Adjustments > Levels) command.

As a green, black, and white tritone, the picture of the house has a completely different mood that I like. And that's really the point of applying duotones, tritones, and quadtones to your digital images. Just because an image is monochrome, doesn't mean you can't add some color to it.

Painterly Effects

Photographers have been applying what many have dubbed "painterly" effects to their images since the Pictorialist movement at the turn of the 20th Century. Digital IR photographers, who are no strangers to this desire to create artistic effects, often use image-processing software to add elements such as a hand-drawn or a pastel look to their pictures.

To begin, look at the program you are using to see what types of artistic effects it offers. For example, built into Adobe Photoshop are many different filters that let you apply these types of enhancements. When you select the Artistic menu in the Filter pull-down, you'll find 15 different effects, such as Colored Pencil, Neon Glow, and Watercolor. But these aren't the only choices. Be sure to check out the eight filters for Brush Strokes (Filter > Brush Strokes) and the 14 effects that can be found under the Filter > Sketch menu. All of these selections are collected under Filter > Filter Gallery, giving you a 37 filters that you can apply to your images.

These artistic filters usually work best on photos that have a strong, simple composition. When you choose any one of these effects, a dialog window appears that lets you control the degree to which various aspects of the filter is applied. Don't be timid when making these judgments; move the sliders to the extreme ends of their scales and see what happens. A resizable preview window will show a portion of the image. Use the plus and minus buttons in the lower left-hand corner of the Filter Gallery interface to zoom in and out of the scene to see the effects of your slider gymnastics. Don't worry about clicking OK to apply an effect. If you determine you went overboard, use the Edit > Fade Filter Gallery command to diminish the effect until you get something you like better.

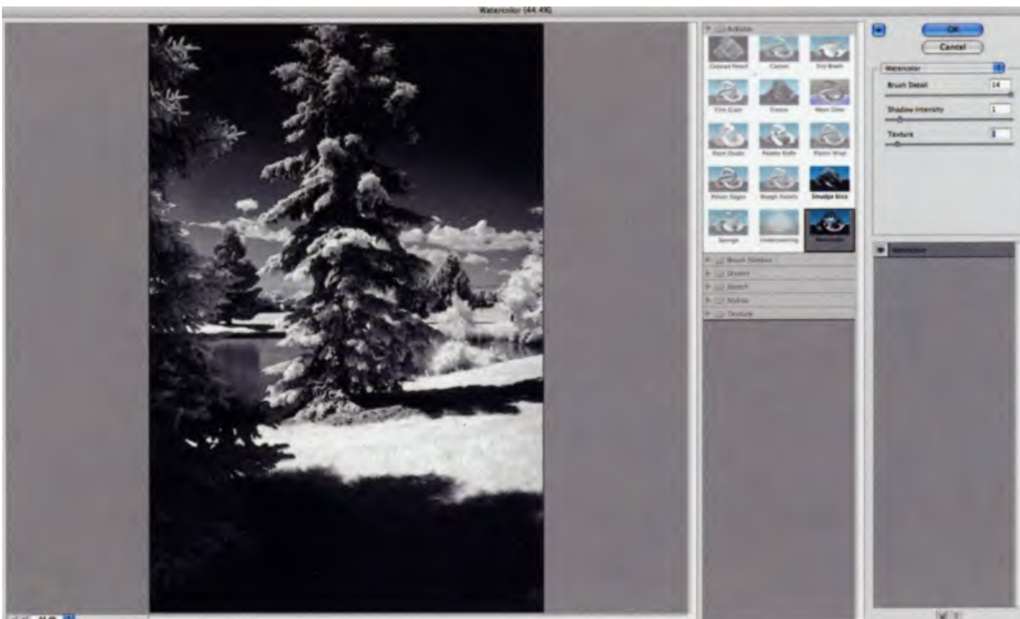


This tree was shot in Colorado using a Canon EOS digital SLR converted to IR use. 1/40 second: f/16; ISO 400.

Creating Digital Art

Step 1: Yes, you guessed it! Open a duplicate of your original image.

Step 2: Open Photoshop's Filter Gallery (Filter > Filter Gallery). In this case I opened the Artistic folder to select the Watercolor filter. While Watercolor might seem an unlikely choice to use with a monochrome IR image, its softness counters the typical hard edges associated with digital infrared images. This filter gives you control of brush detail, shadow intensity, and texture using three slider's.



Photoshop's Filter Gallery contains a number of filters within several different folders, including Artistic, Brush Strokes, Distort, Sketch, Stylize, and Texture. Don't be afraid to try these different effects to see what happens. You can always undo them if you don't like the result.



Do you like the more layered look of this image after the Watercolor filter has been applied?



Don't be afraid to try other effects and see what you like. I applied the Dry Brush filter (Artistic folder) to the original, adding a snowy effect to a photograph that was shot on a sunny summer day.

Step 3: For the final image, I took my own advice and played with the sliders at extreme ends of their ranges. Ultimately I returned to settings that were close to Photoshop's defaults.



"Pine Needles, September 2003." This photograph was taken in the Gatineau Hills of Quebec, just across the river from Ottawa. Even though this was shot on a cloudy day, Rob was able to capture this cool image with a Hoya R72 filter and his Nikon digital SLR. 20 seconds; f/16; ISO 1600; Exposure compensation of +3.3 stops. Photo © Robert Williams.

Profiles In Infrared: Robert Williams

Robert Williams is a professional photographer, based in Ottawa, Canada where he specializes in natural and urban landscapes. In addition to IR photography, Rob is interested in making abstractions from his photographs because he can bend the 'photographic rules' to try new ideas and techniques. He notes that digital cameras and computers are great tools for creating abstract photos because he can attempt so many of these ideas, keeping what works and discarding what doesn't without wasting film.

Rob's work is characterized by the use of strong color and design elements that show his interest of the outdoors. His photographs have been published in *Nature Canada, Canadian Camera,* and *MacLean's magazine*, and have been used by various nature conservation organizations.

Rob uses a Nikon digital SLR with a Hoya R72 filter. He has found digital IR photography a great benefit in terms of ease and convenience over using IR film. His website (www.robwilliams.ca) shows a large number of his photos in several different galleries, as well as articles and essays about his work. Also included is a portfolio of digital infrared photographs along with explanations about how he took each one of them.



"Trees at the Experimental Farm, May 2004." Robert made this at the Arboretum in the Experimental Farm in Ottawa. He says, "The full sun and harsh light made me think of trying infrared." 9 seconds; f/22; ISO 200; Exposure compensation of +2 stops. Photo © Robert Williams.



I started with this photo, shot in black-and-white mode using a Leica Digilux 2 with a Cokin IR filter. 2 seconds; f/2; ISO 400.



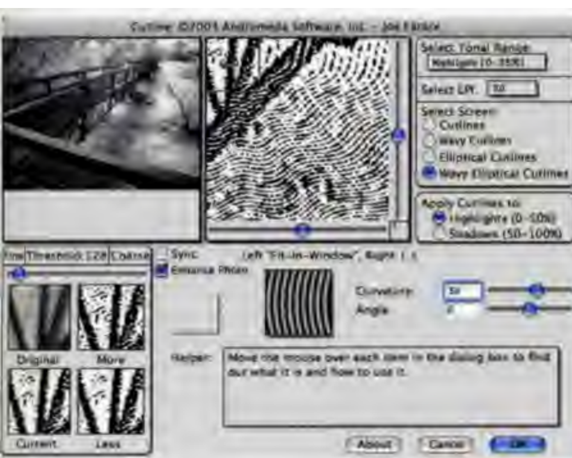
Here, I tried solarization, aka The Sabattier Effect. This interface from Nik Software's Nik Color Efex Pro 2.0 Solarization: Black and White Photoshop plug-in is easy to understand and use. for this image, all sliders were at the default settings.

Solarization or the Sabattier Effect

Another of the filters found in Nik Software's Color Effects Pro 2.0 plug-in is called Solarization: Black and White. In traditional photography, solarizaton, more accurately referred to as the Sabattier effect, is one of the oldest darkroom tricks in the book and works especially well with strong graphic IR images. It was first discovered in 1857 when some photographers noted that exposing a partially developed photographic plate to light, then continuing development to completion, would cause a reversal of tones, rendering all or part of the negative image as a positive. The Sabattier effect is not true solarization, which is an entirely different reversal phenomenon. Classic solarization is the reversal of a portion of an image resulting from prolonged exposure to bright light and was first noted in overexposed daguerreotypes. Man Ray created some prints using the Sabattier effect, called them "solarized", and the rest, as they say, is history.

Woodcut Effect

Let me show you an etching! Andromeda Software's Cutline Filter produces images that resemble engravings and woodcuts. You can get a number of different looks from a single original picture.



Andromeda's Cutline Filter has four built-in screens and tools for positioning and adjusting directional screen lines.



Color me Escher. I used the default settings in Andromeda Software's Cutline Filter to create this engraved effect.

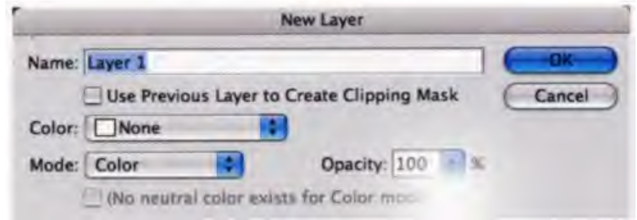
Hand Coloring

In Adobe Photoshop you can simulate the popular hand-coloring techniques of the mid twentieth century, only now you can apply the color much more quickly, and you have a near endless range of color choices from which to choose. But if you make a mistake, you can fix it immediately by using the History Palette (Window > History) to go back to the point before you made the mistake. Even after you are finished with your masterpiece, you can still return to fix a mistake or change a color by deleting a color layer and adding a new one.



This gorgeous old Buick was shot as an IR RAW file. Once we give it a little selective coloring, it is going to look even more beautiful and unusual.

Step 1: You guessed it! Open a duplicate image of your original.



Make sure to select the option for Color in the Mode pull-down.

Step 2: Desaturate your image. If your original is a RAIN tile, like the example of the Buick (left) move the Saturation slider in your RAW converter to its minimum setting. If your file is a JPEG, use the pull-down menu in your image-processing program (Image > Adjustments > Desaturate). Do not convert your image to Grayscale; you must leave it as an RGB or CMYK file.

If you are interested in giving your picture an extra touch, you could add a slight tone (for example, sepia) to the image before applying your coloring, (Image > Adjustments > Photo Filter) or (Layer > New Adjustment Layer > Photo Filter).

Step 3: Here's the key to hand-coloring a picture: Add a Color Layer (Layer > New > Layer), then select Color from the Mode pull-down in the Color Layer menu.

Step 4: Once you add a Color Layer, you will paint on it instead of on the Background. If you try to do this same technique with a standard layer, you will cover all the detail in that area over which you paint.

Select an airbrush from the Tool Bar. You can use the bracket keys on your keyboard to make the brush smaller (left bracket) or larger (right bracket). I picked a color by clicking on the Foreground/Background color squares at the bottom of the tool bqr. This causes a color picker window to appear.



From the Layers Palette you can adjust the color with the opacity slide at the top of the palette.

Step 5: You can fine-tune the chosen color by reducing the Opacity of the Color layer and by adjusting the Colors in Color Balance (Image > Adjustments > Color Balance).

Step 6: You can keep adding additional layers—one for each different color. When you decide you are done, save the file as a PSD to keep the layers seperate for future manipulation. But Flatten (Layer>Flatten Image) the layers and save a TIFF for printing.

Coloring can definitely add sparkle and a unique flavor to your photographs. Enhance just a selected portion of your image to focus emphasis on the most important aspects of your composition.



This IR black and white was photographed with a Canon digital SLR modified for IR photography. 1/200 second; f/22; ISO 800.



I applied Blue Steel Action found in the Fashionizer set from Craig's Actions to add color to my IR photo. Like most Actions, Blue Steel is a one-click application. Press the button and watch it happen.

Actions and Artistic Options

Another useful and fun feature of Adobe Photoshop is called Actions, a collection of short scripts that trigger a sequence of image-processing steps that can be applied to IR or non-IR photo files. With a single click you can use Actions to deliver a variety of different coloring and artistic effects.

The Actions Palette lets users record a sequence of editing steps as an "Action" that can be saved, then utilized again at a future time. An Action can be applied to a selection in an image, another image file, or—in a batch operation—to hundreds of different image files. You can create and save your own Actions, get them from friends, or download them from the Internet. Some are provided by Adobe on their Photoshop CD-ROM in the "Goodies" folder.





I used an oil painting Action to get a soft yellow look, then a snowy Action to turn the summer into winter. Both of these Actions are free to download from the Adobe Studio Exchange website, which has over 10,000 files for you to explore.

Actions are not applications, plug-ins, or even filters; they are simply a series of instructions that direct Photoshop to produce a desired effect. They are easy to use and can be customize based on how you apply them.

The Actions Palette is your key to creating and using Actions. To open it, go to Window > Actions once your image is open in Photoshop. The Palette drops down showing a list of available Actions. To apply, highlight an Action from the list and click the triangle icon (Play selection) at the bottom of the Palette. Voila!

It can be useful to share Actions with other photographers. The sharing process is made easier by the fact that Actions are completely cross-platform. If you create an Action in your Mac OS, anyone using the Windows version of Photoshop can load and apply your original Action to their images. In either Mac OS or Windows, Actions typically use an ".ATN" file extension.

Creative Edges

One of the hottest trends in digital images is a photograph with irregular, ragged, or artistic edges. Even National Geographic has used soft-edged photographs to illustrate a story or two. With image-processing software, it's not difficult to produce these kinds of effects.

Here are some reasons you might want to try adding creative edges to your own photographs:

- Photographs with irregular edges add variety to your portfolio by providing visual relief from straight-edged vertical and horizontal rectangular shapes.

- The edges of images with white backgrounds or light colored corners tend to disappear from the final print. A creative frame adds a decorative border to the photograph, giving the finished image a more clearly perceived edge.

- Instead of cropping to clean-up distracting elements, you can use creative edges to hide minor compositional flaws while adding a touch of panache at the same time.

- Creative edges can add an artistic touch to an image that might otherwise appear too literal.

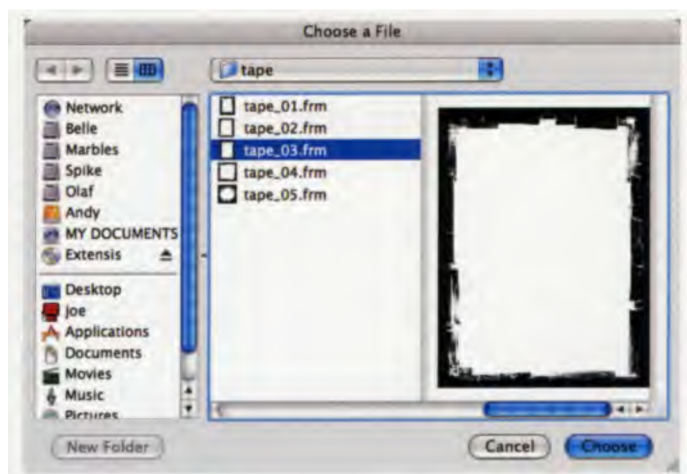
- Playing with creative-edge effects is fun.

onOne Software PhotoFrame

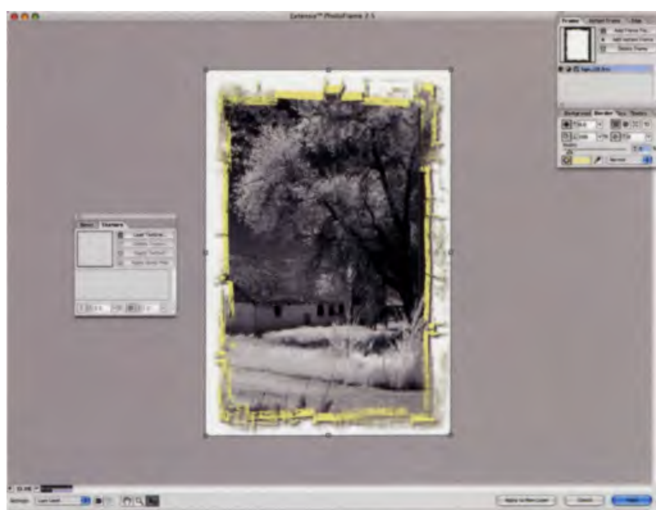
This Photoshop-compatible plug-in provides a huge assortment of frame and border effects. The program lets you enhance your images by adding a variety of special effects to their edges, including drop shadows, inner and outer glows, bevels, textures, blur, noise, opacity, and blends that can allow you to customize and save these special edge effects you've created. It is available for Mac OS and Windows and you can download a demo copy that includes several frame samples.



Let's look at onOne Software PhotoFrame to see how to create edges and frames to enhance your IR photos. This picture was shot with a digital SLR converted for IR photography. 1/200 second; f/22; ISO 800.



The interface for PhotoFrame includes a large, resizable real-time preview window along with dockable palettes that let you maximize monitor space. The editing environment includes multiple Undo/Redo, a pop-up navigator, eyedropper color extractor, background processing, zoom, pop-up tool tips, and vertical pop-up sliders.



PhotoFrame not only works with the 1000 frame files found on the program's CD-ROM, but you can also build your own custom frames and edges from scratch or by adapting existing frames.



You can even use onOne Software PhotoFrame to add a little color to your monochrome image. This frame is one of five frames that simulate transparent or translucent tape so it looks as though your photo is taped to a background surface.

Photo/Graphic Edges

Auto F/X is the company that first made creative-edge effects popular with digital photographers. Initially, they supplied CDs with files for graphic edges that you applied to your images using Adobe Photoshop's tools and commands. While the process was not difficult, some users found it too complicated, so Auto F/X quickly developed a plug-in that made the job much easier.

Photo/Graphic Edges can add torn, ripped, deckled, feathered, painted, film frames, and darkroom-styled edges to any grayscale or color image. The latest package contains four visual-effect modules: Edges, Montage, Vignette, and Frames; each module gives you complete control over the edges of your pictures and also lets you apply surface grain, lighting, shading, matte, or colored backgrounds. The latest version features such effects as Traditional, Darkroom, Painted, Etched Scratchboard, Darkroom Transfers, and much more. Included in the package are more than 10,000 edges as well as hundreds of color frames and texture effects.

Using any of these software tools can be fun. Just open an image and experiment with all of the program's features. Don't worry about making mistakes; there are no mistakes when producing edge effects, just use common sense and good taste. After a while, you'll feel like you want to add edge effects to all of your images, but don't do it. A true maestro of traditional darkroom techniques, the late Edward L. Bafford, warned me that you should have somebody standing nearby with a wooden two-by-four to "knock you upside the head" if you got too carried away with any one particular technique. Use creative edge techniques sparingly and only with images that will be enhanced by the effect, otherwise they will loose their special quality



Watch what Photo/Graphic Edges can do to this image, originally shot with a Canon EOS digital SLR converted for IR photography. 1/80 second; F/16; ISO 800.



Photo/Graphic Edges includes 1000 matte textures and 200 lighting tiles to give you a custom look and a seemingly infinite combination of effects. This program is delivered as both a plug-in and as a standalone application for Mac OS or Windows.



By playing with some of the possibilities in Photo/Graphic Edges, I created this montage-style frame.

Digital Noise

Finally, noise is an additional factor to keep in mind as you attempt to optimize the quality of your digital IR photos. Not only do all digital cameras add sensor noise to images, but noise is also caused by image processing and file compression. Like film grain, sensor noise is more noticeable at high ISOs in areas of uniform color, such as skies and shadows. There are many software packages that help reduce the appearance of digital noise. Following is a short list of products from the many I have tested, in order of my personal preference. Keep in mind that your camera and the kind of images you make may be different than mine, so download a free demo version of each product and try it yourself.

• Noise Reduction Pro

This is the first tool I reach for to reduce high ISO noise, sensor color noise, JPEG artifacts, and color fringing. Unlike the less expensive non-Pro version, it features separate controls for luminance (brightness) and color noise. **It is** not the strongest grain removal product available, but its application avoids the mushy look that some noise reduction solutions produce. Download the 30-day demo versions of both Pro and non-Pro versions of the plug-ins and try each.



This screenshot shows the interface for Noise Reduction Pro.

• Grain Surgery

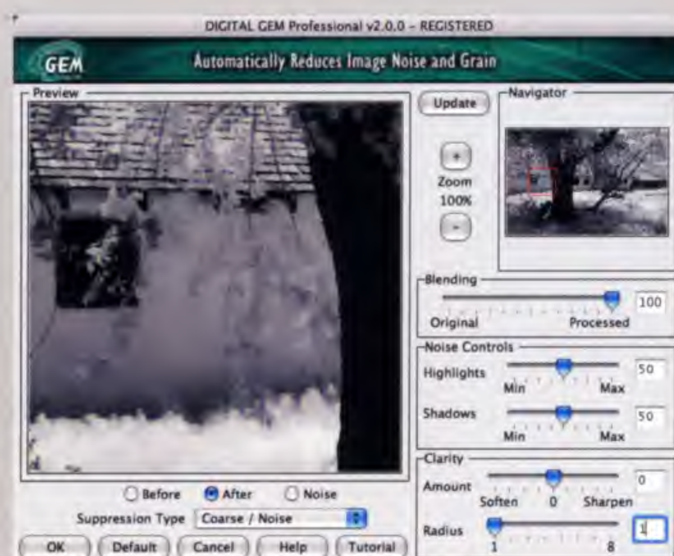
Grain Surgery reduces digital noise, film grain from scanned images, JPEG compression artifacts, and will even remove halftone patterns from scans. The interface provides easy access to all settings, a wonderfully useful split-screen comparison window, and allows you to save your settings and reload them later for similar image files. It even lets you add grain from built-in samples of your favorite grainy film.



Grain Surgery.

• Digital GEM Professional

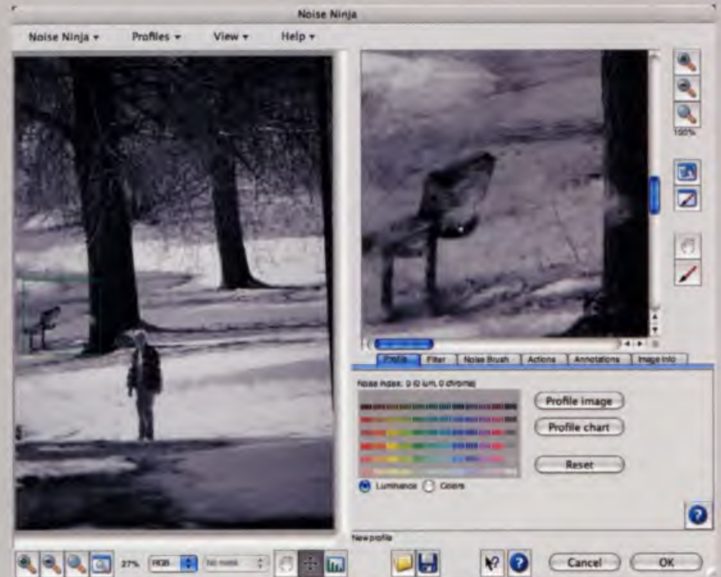
Eastman Kodak's Austin Development Center offers this plug-in that also supports 16-bit images. The Clarity control in its dialog window lets you customize the effects by providing additional sharpening or softening to the overall image, while a Radius slider controls the pixels surrounding the area affected by the sharpening/softening. A Noise Preview Screen shows the actual image noise/grain that's affected by your setting choices.



Digital GEM Professional.

• Noise Ninja

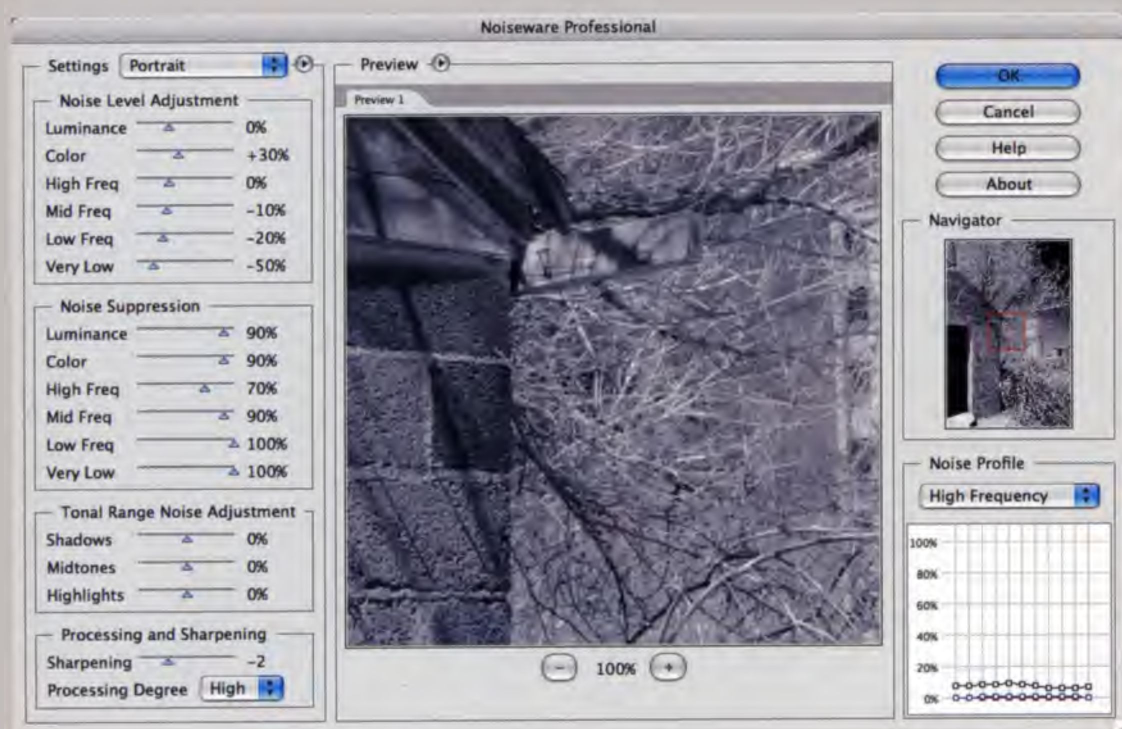
Noise Ninja is available either as a standalone application or a plug-in for Photoshop, which is the way I like to use it. It uses a proprietary type of wavelet analysis that doesn't introduce artifacts, such as ringing or blurring edges. To refine its noise-reduction capabilities, it applies camera profiles that are offerec free on its website.



Noise Ninja.

• Noiseware

This program removes high and low ISO noise, JPEG compression artifacts, and moire patterns, and is available as a Photoshop-compatible plug-in or standalone application. It contains a 'self-learning' algorithm to collect data about your camera or scanner that allows it to continuously improve the processing every time you run an image through it: The more you use Noiseware. the better the results.



Noiseware.



Eric used a Nikon Coolpix 990 with the hot-mirror removed and a Tiffen #87 glass filter. 1/38 second; f/2.6; ISO 100. Photo © Eric Cheng.

Profiles In Infrared: Eric Cheng

Eric Cheng was one of the pioneers of near infrared digital photography with consumer cameras. He has been taking digital infrared photographs since 1998, and has written extensively about the technique in a number of publications, including *PEI* magazine, *Digital Photo FX* magazine, *DigitalFOTO* magazine. He has also contributed to the books *The Future of Memories* and *The Advanced Digital Photographer's Workbook.*

Though the camera that took the pictures above had the hot mirror removed, Eric points out that shooting infrared with digital cameras can be as easy as attaching a visible-light blocking filter to the front of the lens. A good first filter to try is the Wratten #89B. He says, "You should be able to capture images in infrared after you securely attach the filter to the front of your camera and shoot with flash turned off. Using a tripod is essential, because your camera will almost certainly be shooting at low shutter speeds!"



Eric used the same camera for this image with an exposure of 1/119the of a second at f/4.9 with an ISO 100. Adobe Photoshop was used to convert the image to black & white and selectively soft-focus (Gaussian blur, sharpening, and masking) the skin areas to simulate the haloing of infrared film. Photo © Eric Cheng.

Eric is also a professional underwater photographer, and is the editor of *Wetpixel.com,* an award-winning website and online community dedicated to digital underwater photography. More about Eric can be leaned from his personal website: http://echeng.com

Creating Infrared Effects

"My true program is summed up in one word: life. I expect to photograph anything suggested by that word which appeals to me." Edward Weston



You've read about shooting IR images with either an IR-converted camera or a conventional digital camera using IR filters, and how to enhance those pictures using image-processing software. But what if your digital camera does not have very good IR capability? Or what about that large library of non-IR digital shots you already have? Some would make great infrared images with a bit of digital darkroom magic, wouldn't they? Don't worry; you can use digital technology to create the infrared look with non-IR photos.

Powerful Plug-ins for Conversion to IR

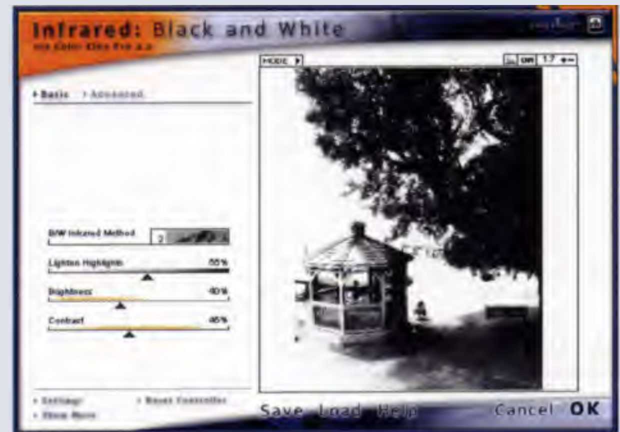
We've already examined a number of different uses for plug-ins. Just as they were compared to power tools when converting digital color IR images to black and white, they are also available to create faux IR images from conventional photos.

For example, an assortment of filters in the Exposure plug-in from Alien Skin Software allows you to recreate the specific look of particular film stock. This plug-in allows you to replicate the look of such IR films as Ilford 200SFX, Kodak HIE, and Konica 750.



The Pebble Beach golf course was photographed in visible light using a conventional digital photo point-and-shoot camera. This image is comprised of five separate photos, which were stitched together using the PhotoMerge feature in Adobe Photoshop. Finally, a transformation to faux infrared was created with Nik Software's Nik Color Efex Pro 2.0.

There are two infrared conversion filters in Nik Software's Nik Color Efex Pro 2.0 package that are also designed to imitate the look of photos shot on infrared films: Infrared: Black and White and Infrared: Color. The Infrared: Black and White filter can be used to create stunning landscapes, with dark skies, bright white clouds, and glowing white vegetation. This filter also produces excellent results on a wide variety of other subjects, from portraits to travel photographs. The Infrared: Color filter produces images with interesting color shifts.



You can't see them all in this illustration, but there are four choices for effects in the pop-up menu for Nik Software's Infrared: Black and White filter. This one created the effect I liked best. Try them all before clicking OK.



While this photo of a gazebo and lake was rather unspectacular, I thought it could be transformed in the computer. 1/200 second; f/11; ISO 200.



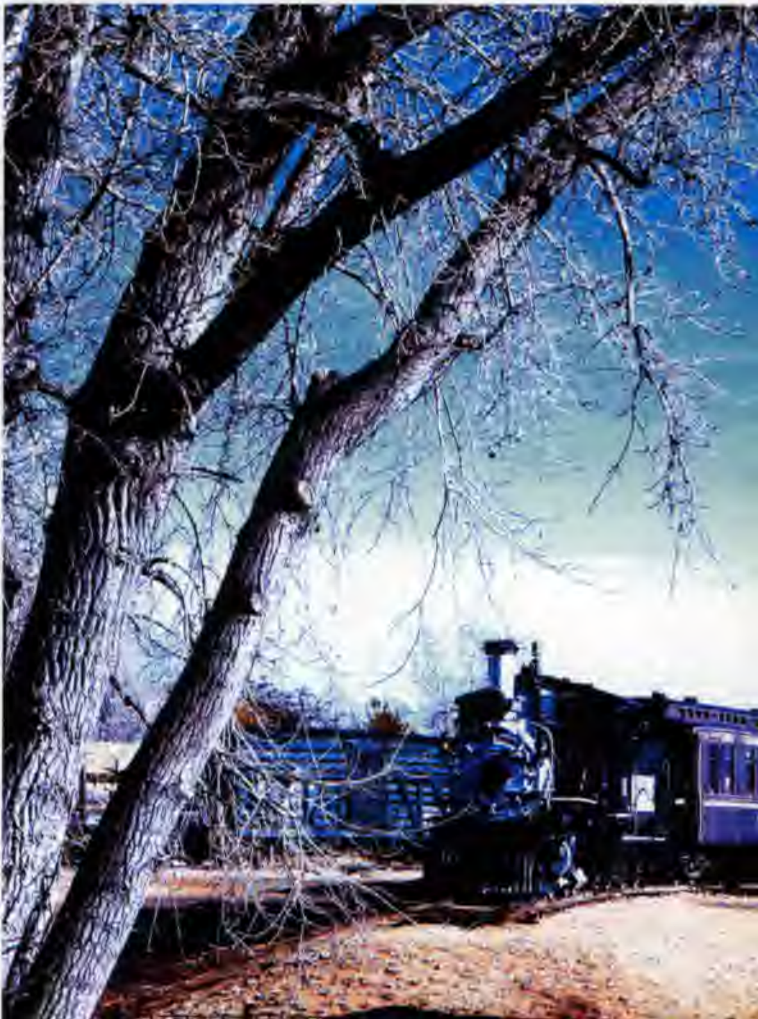
The monochrome rendition and the shimmering white in **the** grass and tree help simplify and strengthen this composition.



A color digital photo made at the Colorado Railroad Museum.1/125 second; f/8; ISO 80.



Nik Software's plug-in, Infrared: Color, imitates infrared color film. Like the black-and-white version, its control panel let's you preview different effects to select the one you like best.



No foliage? No problem. That's the time to create some faux-color digital infrared. Again, this is an example of an image created with Nik Software's Infrared: Color.

Another simple alternative is to take a conventional digital color image and convert it to look like infrared using a different plug-in, Silver Oxide's Silver IR filter. Based on the photo's spectral signature, an indication of the IR reflectance contained in different components of the scene, Silver IR uses a proprietary algorithm to separate parts of the image and create an IR simulation.



This digital image was shot with a Fuji Finepix 3800 digital zoom camera. What would those leaves and sky look like in IR? 1/100 second; f/8; ISO 100.



The interface to Silver Oxide's SilverIR filter may look complicated at first, but it is not difficult to figure out. This filter will create an "infrared image" from a standard color digital file.



I used the default setting to produce this result. Now I know what those leaves and sky look like in IR.



This 1931 Ford Model A station wagon is not your typical subject for infrared photography, but I wonder what it might look like in IR. Don't let anybody kid you; there are no specific subjects you should or should not photograph in infrared. Let your interests be your guide. 1/500 second; f/3.5; ISO 125.

True-Pro-Converter from AboutDigicam is a single Photoshop-compatible plug-in that provides a number of digital conversions, turning color files to black and white, sepia, and infrared. It also lets you emulate Fuji's Velvia film, normal or saturated, as well as color infrared. The upside of this clever product is that it is relatively inexpensive. The downside is that it is only available for Microsoft Windows. Sorry, Macheads.



One of the joys of using a versatile plug-in is simply clicking a button to preview a number of possible effects. AboutDigicam's True-Pro-Converter will easily convert a digital image to enhanced color, monochrome, IR color, or IR black and white. When I saw how cool the Woody looked as an IR shot, I knew it had to appear in this book.

A psychedelic woody sounds like something Janis Joplin might have sung about in the sixties, but here it is today as a faux color infrared thanks to True-Pro-Converter's set for conversion to color infrared. The picture is pretty enough to frame, so I added a digital frame with AboutDigicam's free Photoshop Action.





Not So Pseudo-Infrared Color

This photo looks like it may be a faux infrared image, but don't be fooled. By now we know that color IR image files shot with a filtered or converted camera produce magenta images that have to be converted to black and white to get the look you want—or do they? That may well be true when shooting in a highly intense IR-filled environment, but what happens when that isn't the case?

This photo is one result, and I like the softer look. It was shot in the soft light of my north-facing kitchen with a Canon EOS digital SLR converted for IR. It may not be crisp, but the colors you see are exactly as the file was recorded on the memory card. Model Tia Stoneman's auburn hair translated in-camera into a very cool blue. (Handheld; 1/13 second; f/16; ISO 400.)

If there is any message here, it's that you should always experiment! Don't take what anybody, including me, says as the absolute truth unless you try it yourself. There are too many variables in digital IR photography for it to be "my way or the highway."

Using Actions

Remember Actions from the last chapter? Well, they can also be applied to non-IR images. Go to the Windows pull-down and click Actions to see the Actions Palette. A list view of available Actions will appear.

You can create and edit Actions by using the New Action command, found in the pull-down selections by clicking the right-facing triangle in the upper right corner of the Palette, or at the bottom of the Palette by clicking the page icon with the corner turned up (Create new action).

You can take a different view of the Actions Palette by checking Button Mode in the pull-down activated by the upper right triangle. When Button Mode is selected, you will see a check mark next to it and you can now click a button to play back any actions you may have created.

While in either Button Mode or List view, new Actions can be added to the palette by selecting Load Actions from the pull-down menu. This command brings up the standard Open dialog window, allowing you to select and load your new .ATN file. When a new Action file is added to the palette, it is placed at the bottom of the scrolling list. If you want to move an Action, switch into List view and click and drag it to wherever you want.

Although Actions can be used to apply creative effects, they are not filters and don't have to be treated like filters. Some pundits recommend that you store them in a folder or directory and load them as you need them. I don't think that's a good idea. One of the main attractions of Actions is that they are a convenient way to accomplish tasks. Since the Actions Palette is scrollable, I think you should keep all of your favorite Actions stored there ready for use. The trick is not to blindly accumulate Actions, but to explore and test to find ones that fit the way you work. If you uncover a marginal Action, store it in an "Inactive Actions" folder (or send to the trashcan, if you wish).

Since most Actions take less than 10K, you don't have to be worried about download time (or hard disk space). There are not as many Action websites as there are those dedicated to plug-ins, but a few sites combine Actions and plug-ins. One source for pre-recorded Actions on the internet is Adobe Studio Exchange. This well-produced site has a section that lists all of its Actions available for free download, showing a sample image of what the effect looks like.

This scenic image was originally shot on Kodak Ektachrome film with a Nikon FM2 camera. It was digitized using a film scanner.

The *B&W* Infrared Action that **is** part of the Film & Grain Fx Simulator Action set by das bosun **is** found on Adobe's Studio Exchange website. It imitates the look of Kodak's High Speed Infrared (**HIE)** black-and-white negative film exposed with a red filter.

Film & Grain Fx Simulator by das bosun

This is a set of Photoshop Actions, found in Adobe's Studio Exchange Resource Center, that emulates film and printing techniques. It simulates contemporary as well as historic film processing and printing techniques, including cross processing, infrared (color and black and white), cyanotypes, litho prints, and many more. These actions are not recommended for images embedded with ProPhoto RGB color space or other similar wide gamut color spaces, but they work great with sRGB & Adobe 1998 files.

Black and White Infrared Film by Rozilynn

This is another Action from Adobe's Studio Exchange Resource Center that imitates the look of black-and-white infrared film. It works best on images containing foliage, but the author suggests that you "try it on anything; you never know what you'll get. It's not the same as regular black and white, it's a lot contrastier, and has a dreamy effect."



Black and White Infrared Film by Rozilynn is another action found on Adobe's Studio Exchange website. It produces a different black-and-white look than the B&W action in the Film & Grain Fx Simulator set.

Craig's Actions

This is a suite of commercially available Actions that includes InfraRedders, found in Craig's Storytellers One product. With Actions for a number of IR effects, including custom effects for portraits and "ExtraStrong," you always have control over the look you want to achieve and the ability to modify it at any time. Craig's Actions offers sets for black-and-white as well as color IR.



Craig offers an excellent set of actions for black-and-white infrared (above) plus the best color IR Action I have ever tried (as demonstrated to the right).





Cross Processing

Back in the old days of film, one very neat way to get special effects was to use a technique called cross processing. This could produce a result that was often similar to color infrared film photography. It was easy to do, required no filters or special handling, and looked cool.

Processing negative film in transparency chemistry is called C-41 to E-6 cross processing, while processing transparency film in negative chemistry is called E-6 to C-41. The C-41 to E-6 cross process causes highlights to shift to a warm, peach color, while the shadows take on a blue cast. The E-6 to C-41 cross process creates a contrasty image, with blue highlights and detail fringes.

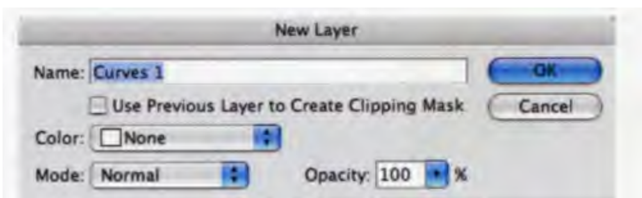
Cross processing can be emulated in digital photography using image-processing software. One method for digital cross processing that creates really good results has been developed by Danny Ngan. His technique aims to produce a dramatic film-based look while keeping the process as simple as possible.

In Adobe Photoshop, use Adjustment Layers so it is easier to adjust the settings to get an effect that you like. This control also allows you to apply different variations and the ability to judge their effect by turning them on and off.



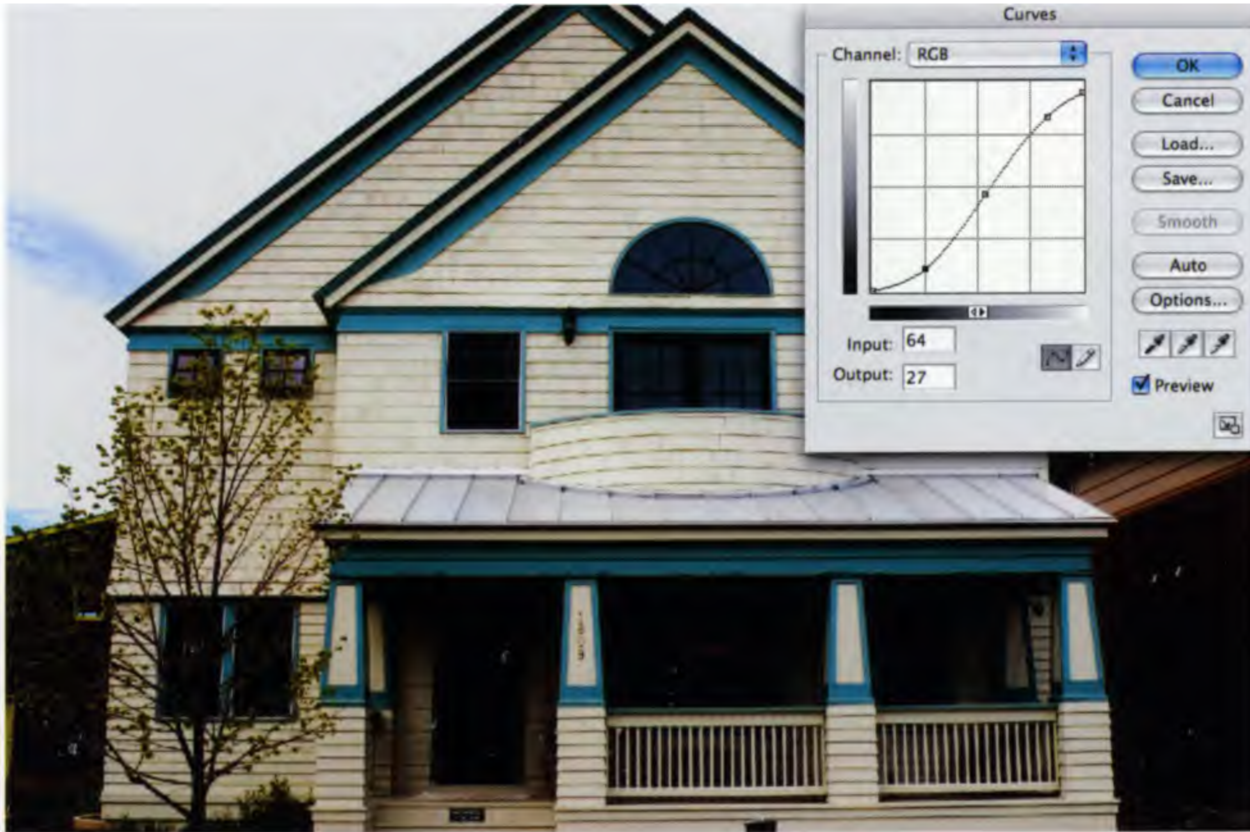
This is an example of the faux-color IR effect you can achieve with true chemical cross processing. The house was shot on color negative film but developed with E-6 chemicals for color slide film. It's not always easy these days to find a photo lab that can do this for you.

This conventional color photograph was shot with a Canon EOS digital camera. Use it as a basis for comparing the faux or pseudo IR effects demonstrated in this chapter. 1/180 second; f/9.5; ISO 100.

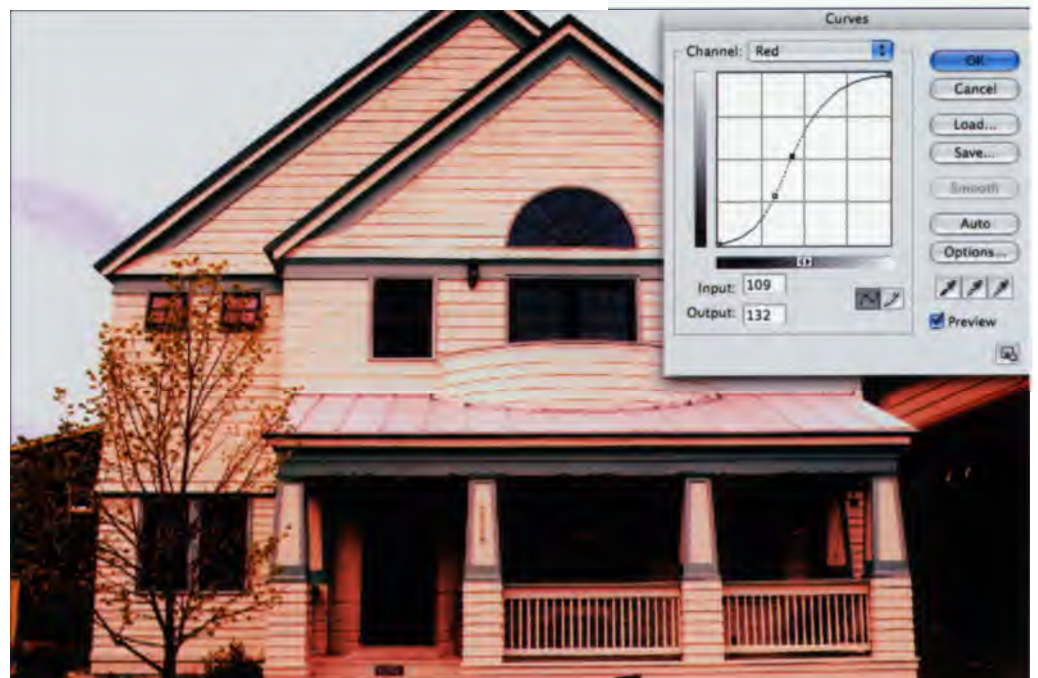


The dialog window for creating a Curves Adjustment Layer. Click OK to see the Curves dialog window appear.

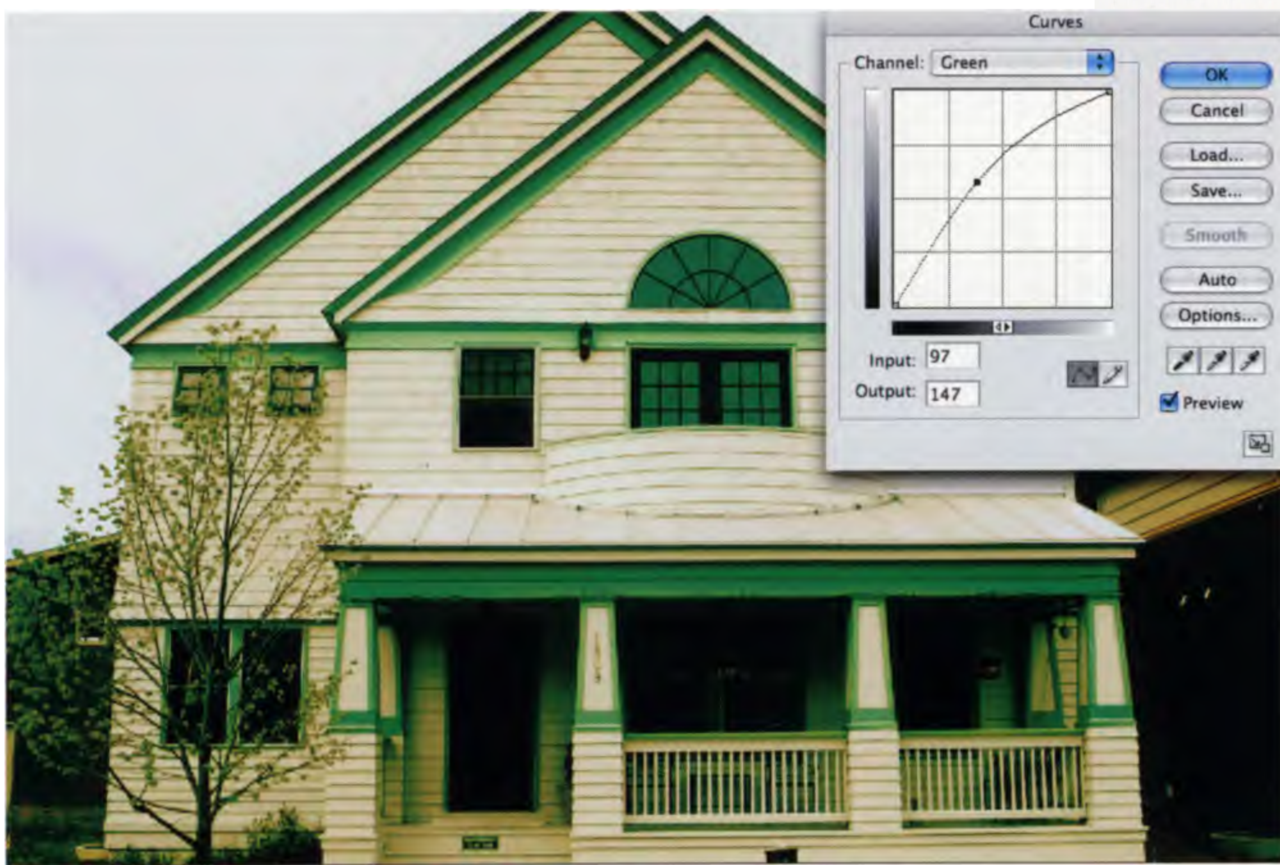
Step 1 With a copy of the source image open, start by creating a Curves Adjustment Layer. This can be done from the menu bar (Layer > New Adjustment Layer > Curves), or you can use the Create Adjustment Layer button at the bottom of the Layers Palette (it's a black and white circle icon.) Name the new Curves Adjustment Layer if you wish and click OK.



Step 2: When the Curves dialog window opens, choose RGB from Channel options at the top of the box. Then click on the grid to create a point that can then be used to adjust Curves. A curve shape similar to the illustration above works well, reducing the darker tones and increasing the lighter tones to produce more dramatic lighting. But don't be afraid to experiment. With the Preview box checked, you can adjust the shape of the graph while watching the effect on the image. You can always click the Cancel button and try again if you don't like the way your adjustments look



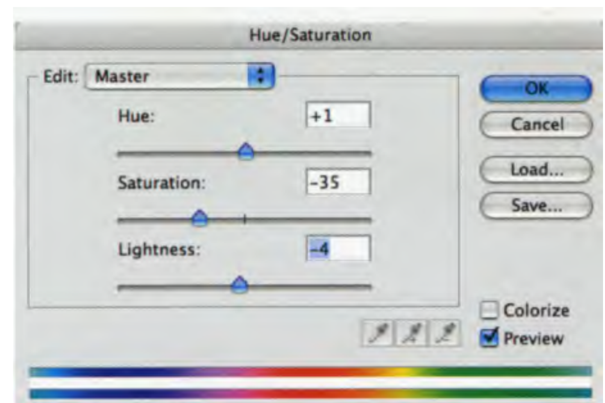
Step 3: Adjust the individual (Red, Green, and Blue) color channels in the Curves dialog window by selecting your desired channel in the pull-down menu at the top of the box. For the Red channel, increase the contrast, making the shadows darker while keeping some red visible in the picture.



Step 4: For the Green channel, keep most of the dark tones where they are, but brighten the midtones and reduce the lighter tones to add a more green-yellowish tint to the image.



Step 5: Adjust the Blue channel, then apply the changes for the Curves Adjustment Layer by clicking OK. If you like the results, you can save settings made for all the color channels in the Curves dialog window for use on another image.



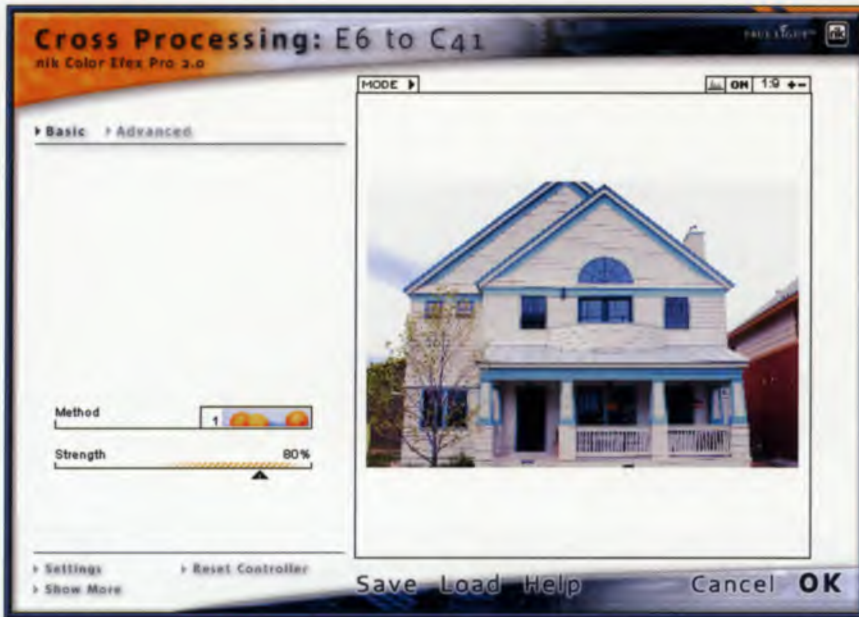
Step 6: Add a Hue/Saturation Adjustment Layer. The resulting dialog window contains slider controls and a pull-down menu for making adjustments. These options let you adjust not only the hue and saturation, but also the brightness of either the complete master or a specific color component of an image. Play with the Saturation slider to add some punch. Bam!



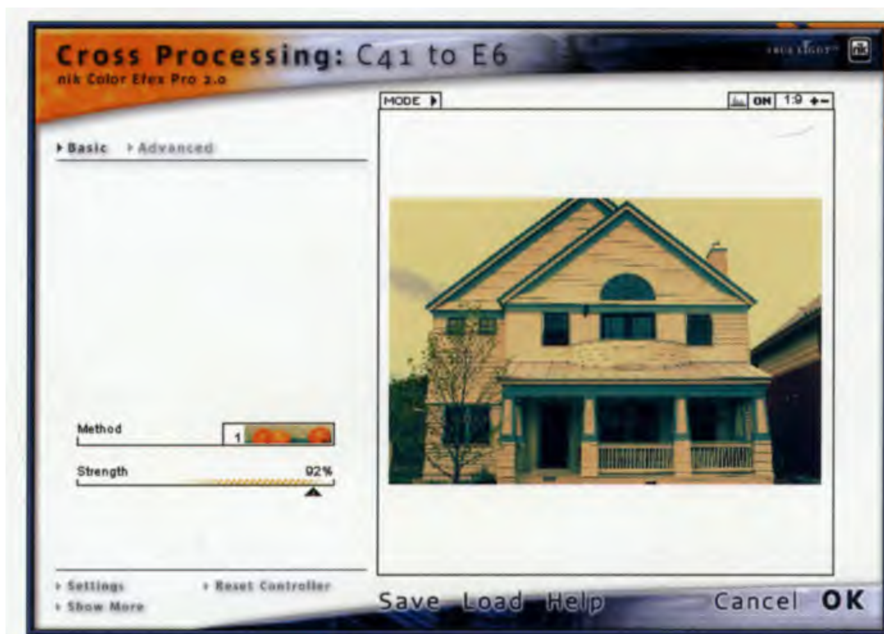
Cross Processed? Maybe not in the "official" sense, but this method definitely produces a color infrared effect. How does this stick-shift method of moving step-by-step compare to using an automatic power tool? You'll soon find out.

Do Your Curves Look Like Mine?

For your particular photographs, the curves in the dialog windows may look different than my examples, depending on the source image's colors. But the primary goals in this faux cross-processing method are to increase contrast, create dynamic colors, and add a slight tint to the overall image. This was a relatively high key (lighter tones) image. You can see Dan Ngan's process using a low-key (darker tones) image file at his blog site listed in the back of this book. The bottom line: Experiment with different combinations of adjustments to get a look that's pleasing to you.



The E-6 to C-41 cross-processing plug-in from Nik Software may produce an image that is less refined than Danny Ngan's technique, for instance lacking a bit of glow and yellow tone. But the plug-in is fast. The loss of subtlety is the price you pay for speed.



This is cross processing in the opposite direction, using Nik Software's Cross Processing: C-41 to E-6. Clearly this process yields its own type of look.

Cross-Processing Plug-ins

The preceeding method is fine for those who want precise control over each step of the cross-processing procedure. But there are plug-ins for this technique that give you results much more quickly.

One package that is very effective is Nik Color Efex Pro 2 from Nik Software. This set of Photoshop-compatible plug-ins offers both E-6 to C-41 and C-41 to E6 cross processing effects.

Reggie Linsao started his career as a nature photographer. He has found digital infrared IR "to be the perfect complement in the digital age." He continually asks himself how a subject would look if shot in IR, and that's a question you should continually ask yourself, as well.

While Reggie appreciates the black skies and white trees found in black-and-white IR, as a nature photographer he loves color. These examples of his work show how he incorporates color into his IR photographs.

When he began shooting IR, Reggie experimented with the white balance settings in his camera, then graduated to creating a custom white balance he uses for his IR photography: "I was all set up with my Canon Poweshot G3 and took the photo of the waterfall below with the IR filter on, and used that photo as my custom white balance setting. I metered off of the bands of water in that picture, which interestingly enough were actually a yellowish-brownish color to begin with. My custom white balance will give consistent results, but I've also discovered that the angle of the sun to your subject can influence the intensity of the colors."

Visit Reggie's website to find IR photographs and articles about his observations and techniques: www.boomslice.com



"Watermane" was one of Reggie's first successful white balance experiments. In addition to the color, note the reflection at the top of the falls compared to the swirling water below. This one was also photographed using a Hoya infrared R72 filter. The exposure was 13 seconds at f/5; no ISO was recorded. Photo © Reggie Linsao.



"Triad" captures the detail of the bare branches against a warm sky. Reggie does not recommend shooting into the sun, but in this case it adds drama. He used a tripod-mounted Canon PowerShot advanced compact zoom digital camera with a Hoya infrared R72 filter. 5 seconds; f/3.2. No ISO was recorded. Photo © Reggie Linsao.

Printing IR Images with Ink Jet Printers

"...the picture-taking process...is an intuitive thing. You can't go out and logically plan a picture, but when you come back, reason then takes over and verifies or rejects whatever you've done. So that's why I say that reason and intuition are not in conflict—they strengthen each other." Wynn Bullock.

Ansel Adams, who was also a pianist, often compared photography to music. He felt the act of shooting a photograph was akin to the production of the musical score, but the finished print was its performance. Nowadays it is more than likely that a print will be digital than silver-based.

Printing photographic images in your desktop "darkroom" means no more working in the dark with fingers soaking in smelly, maybe dangerous, chemicals while waiting for results to appear on dripping wet paper. This is not to demean traditional darkroom methods; there is nothing more luminescent than a platinum or palladium contact print made from a properly exposed large-format negative. Printing using digital technology is simply the latest link in a chain that started when Louis Jacques Mande Daguerre placed a silver coated copper plate in mercury vapors and watched an image appear.

Some photographic purists may scoff at digital printing, claiming that images created using computer technology are not permanent, but the truth is that while some traditional photographic prints may be processed to assure permanence, many are not. In comparison, some digital prints are produced using inks and papers that will create an archival print, while others are not. The choices made when printing, whether through experience or inexperience, determine the final result.

Inks and Papers

We all know how today's photorealistic ink jet printers and papers work together, don't we? All you have to do is stick some paper in the printer, tell your image-processing program to print photo-quality output, and the results are always perfect. Right?

Printing is simple if you use Canon paper with a Canon printer, or Epson media in an Epson printer. The driver software from such printers is matched to their own brand of paper, so there are few surprises when you see the output.

But what happens if you use different media with your brand-name printer? The printed results may not look great. So here's a little primer on printers.



All ink jet printers spray ink through nozzles, or jets, onto paper. The technology used to print images falls into two general categories:

• Micro Piezo: Much like a tiny Super Soaker, the micro piezo print head, used primarily in Epson printers, squirts ink through nozzles using mechanical pressure. Depending on the amount of current applied, the print head changes shape to regulate the amount of ink released.

• Thermal: In this system used by Canon, Hewlett-Packard, Lexmark, and others, ink in the print head is heated to its boiling point so it expands before it is forced through the print head's nozzles and onto the paper. There are variations in how each company accomplishes this, but you get the idea.

The amount of ink that exits the print head is measured by its droplet size. In general, the smaller the size, the better the image quality. Ink droplets are measured in picoliters, which are one million millionth of a liter! Printer resolution is rated in dots per inch, or dpi. A 720 dpi device prints 518,400 dots of ink in one square inch (720 x 720). The greater the number of dots, the higher the printing resolution. Be careful not to confuse these specifications with image resolution—they are two different things!



Photo © Carl Schofield

Printing Your Photos

One of the first things digital photographers usually want to do after shooting an image is to print it. Printing is one area where technical advances have freed us from most of the restrictions of the traditional darkroom. For most photographers the intended use of prints is along the classic line of the three "P's"—proofs, prints, and portfolios.

Proofing

Digital color printing got its start as a proofing device for making a quick approval print for a client before producing separations. Many photographers still use their desktop printers for this purpose. A paper proof printed on relatively inexpensive but high quality digital media provides insurance that the final 4-color process print will look the way it is supposed to look. Making a paper proof is also a good idea when sending a digital file to a client or service bureau so the recipient knows what the finished image should look like. I made proof sheets of all of the images for this book to give the separator an idea of how the picture should look when printed.

Printing

The papers and inks used by the latest ink jet printers generally produce prints that last as long as a lab-made print. For most applications, the people receiving the prints don't even ask if they're "digital" because they look just like "real" photographs.

Portfolios

One advantage of making digital prints for this type of use is the ability to update and customize each portfolio that you send out. Having a good ink jet printer lets photographers print high-quality portfolio images up to 13 x 19 inches (33 x 48 cm).

Managing Accurate Color

The revolution in color ink jet technology forever changed the nature of desktop printing. For less than $100, inexpensive printers from companies such as Canon, Epson, HP, and Lexmark, let you produce photographic-quality output, but there is a price to be paid for this capability: Excellence becomes the accepted standard. As color printers have become better and better (and cheaper too), end users have begun to demand more from them: Not just higher resolution, but more accurate color. This quest has engendered an endless cycle of printer improvements, all developed to achieve color nirvana.

Before arriving at the destination of accurate color, there are many roadblocks that must be overcome, including price. Somewhere along the way, you are going to have to stop and ask yourself this question: "How much am I willing to pay for accurate color?" Your answer determines which of the many software and hardware solutions are appropriate for your situation.



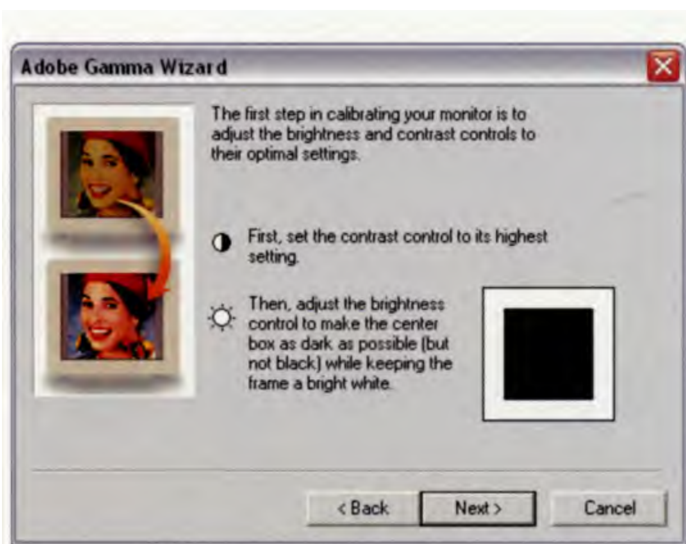
The color temperature of Ott-Lite's VisionSaver Plus table lamp is 5100-5300 K. It is designed to simulate natural daylight indoors. Photo courtesy of Ott-Lite Technology.

Lord Kelvin and the Temperature of Light

In the nineteenth century, Lord Kelvin, an Englishman, proposed a temperature scale suitable for measuring low temperatures. He suggested that an absolute zero temperature should be the basis for his scale. Lord Kelvin's idea was to eliminate the use of negative values when measuring low temperatures with either the Fahrenheit or Celsius scales. In honor of his contributions, this system is called the Kelvin scale and uses the unit "Kelvin" (sometimes written as K). The color temperature emitted by light sources is measured on this scale. The sun on a clear day at noon measures 5500 Kelvin. On an overcast day, the color temperature of light rises to 6700 K, while 9000 K is often what you'll experience in open shade on a clear day. These higher color temperatures are at the cool, or blue, end of the spectrum. Light sources with lower Kelvin temperatures are on the warmer end of the spectrum. Lights used by videographers or photoflood lights usually have a Kelvin temperature of 3200. Household light bulbs measure about 2600 K. A sunrise may be well down on the Kelvin scale—at about 1800 K. So what's my point? Well, in this case, just that you should consider the color temperature of the light source when viewing prints.

There are a few obstacles standing in the way of obtaining an exact color match between what you see on the monitor and what your printer will deliver. The most fundamental difference involves the fact that a computer terminal displays an image by transmitted light. This is similar to viewing a slide on a light box: Light is coming from behind the image. When looking at a print, you are seeing it by reflected light. And this difference can be exacerbated by environmental factors, including monitor glare and the color of the light source you are using when viewing the print. While light may appear white to our eyes, it actually comes in many hues.

If you go into any professional photographic lab or a commercial printer, you'll find a special area set aside for viewing output. This area will have test prints posted and will have lighting fully corrected for daylight. If it looks good in the viewing area, it'll look good anywhere. Most computer users can't afford the kind of viewing boxes professional labs have, but Ott-Lite sells affordable accessory lamps that can bring color-correct viewing to your desktop printer. They offer a family of modestly priced VisonSaver lights that you can place near your printer to help you see color properly. Ott-Lite's 13-watt Portable lamp, for example, should fit into anybody's workspace.



Adobe Gamma can calibrate and characterize your monitor: Calibrating brings it into compliance with a standard; characterizing creates a profile that describes how the monitor is reproducing color.

Monitor Calibration

Very often somebody asks me: "Why don't my prints look like what I see on my screen?" The answer, Brutus, lies not in the stars, but in color management.

Once you're aware of the effects that different lighting has on output, you need to bring the separate elements of your computer system into color harmony. Actually, your software and printer "think" the monitor is displaying something that resembles the print. The key is in knowing what the color of your image is to begin with.

Color management begins with your monitor, whether it is an LCD or a CRT display. The first step is to use Adobe's Gamma software, included with recent versions of Photoshop and Photoshop Elements. The Gamma Control Panel lets you calibrate your monitor's contrast and brightness, gamma (midtones), color balance, and white point. One way to work with Gamma includes a step-by-step wizard approach. Another, with more detailed information for setting Gamma, can be found in Adobe's on-line technical guides. The settings you obtain by working with the Gamma control panel are used to create a profile for your monitor, which can be used by color management systems such as ColorSync for the Mac OS and Microsoft's ICM for Windows.

With Adobe's Gamma, you have to make calibration judgments based on charts that the software displays on your monitor. In other words, you "eyeball" it, which means the display can vary based on a number of factors, including current lighting conditions.

Remember to calibrate your monitor on a regular basis. Colors change as the monitor ages. While Gamma isn't perfect, it will get you into the ballpark. The better the color match between your monitor and prints, the pickier you may become in narrowing remaining differences. The secret in pursuing the quest is not to hunt until the color dragon is slain, but until you are satisfied with the match between monitor and print.



Monaco Systems offers a device called an Optix XR colorimeter to help calibrate your LCD or CRT display. Photo courtesy of X-Rite Photo Marketing.

There are a number of products you can purchase separately that use hardware devices to measure the color display with more accuracy than you can with your eyes. These include the OPTIX XR from Monaco by X-Rite, Eye-One Display from Gretag Macbeth, and Colorvision's Spyder2. These colorimeters can assist you in calibrating virtually any computer monitor and will produce International Color Consortium (ICC) profiles for Mac OS and Windows color management systems.

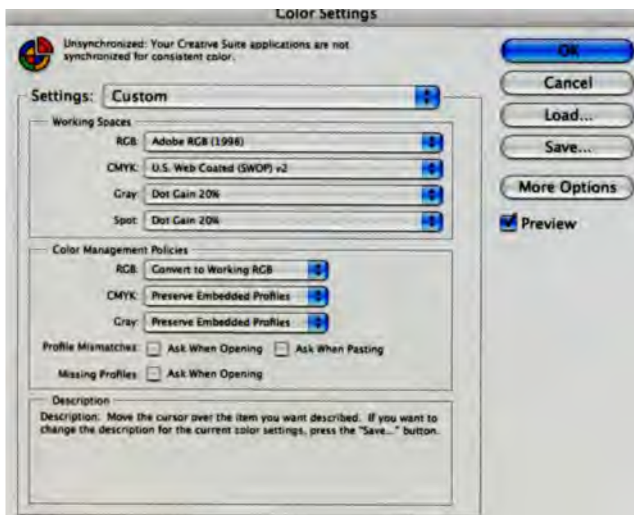


This ColorVision Spyder2 is a device that attaches to your LCD or CRT monitor, the way you may already have stuck a stuffed Garfield there. When used with ColorVision's software, such as PhotoCal or OptiCal, it's relatively simple to calibrate your monitor. Photo courtesy of Datacolor.com.

Color Spaces

Another important task is to make sure your image-processing program's color settings or color spaces are appropriate (Photoshop > Color Settings). The defaults may be fine, but not every photographer has the same requirements. If you're unsure about settings, you can contact a computer consultant or ask a friend in your camera club what setting he or she uses.

The only selection I change is the Working Space. I keep it set at Adobe RGB because that color space was designed for printing with CMYK inks and includes a wider range of colors (gamut) than sRGB (which was developed to match a typical computer monitor's color space and is the default for software on the Windows platform). sRGB is also the color space tucked inside most digital cameras, though some give you a choice of sRGB or Adobe RGB. Check your instruction manual for more information.



If you use Photoshop, try the default settings to see if they work for you and make any changes based on experience.

Output Solutions

You may find after you've tried one of these monitor calibration methods that, while your on-screen image and output have become a much closer match, they are not quite the same. (Don't forget differences in reflective and transmitted light. In my own case, after using Adobe Gamma and one of the color management systems, the result was that output from my printers looked better than it did on screen.)

If you're still not happy with your prints, it's time to look at output profiling. A profile is a file that tells your monitor (or any other device) to associate a number based on specifications created by the International Color Consortium (ICC) with a measured color. When your computer communicates color information, it transmits this numerical data and specifies how those numbers should appear. Color management software takes this profile into consideration and adjusts the device accordingly.

There are two kinds of people in this world of desktop darkrooms: Those who need output profiles and those who don't. When using ink jet or even laser outputs as a proofing medium, prepress users know output profiling is critical. Photographers using ink jet output as the final product have different needs from prepress users—all they generally need is for the prints to match their monitor or their original vision of how the image should appear—what Ansel Adams called previsualization

Monaco EZcolor builds ICC monitor, scanner, and printer profiles that produce accurate and consistent color across devices and paper types. A wizard-like interface guides users through the entire profiling process. X-Rite also packages a color management system that includes MonacoPROOF software and X-Rite's Digital Swatchbook spectrophotometer. Digital Swatchbook works with Macintosh or

Baby Can I Drive Your Printer?

After connecting your printer to a computer, you need to install software that lets the two devices communicate. This is called "driver" software because it drives the printer and makes it work.

With Mac OS computers, I prefer to insert the driver software CD-ROM, and then double-click the icon to make it work. With Microsoft Windows computers I've found the most prudent way to install printer drivers is by connecting the printer and restarting the computer. This will cause Windows' Plug-and-Play feature to recognize that a new device is connected and will guide you through the process of installing the driver. While more experienced computer-users may feel they can just install the hardware, then install the software, I've often found that when working with some printers, not using Windows' feature for plug-and-play installation can create problems with partially installed software. This is more trouble to fix than simply letting Windows guide you through the installation in the first place.

Windows computers using measured spectrophotometer readings for color managing desktop computers. MonacoPROOF builds custom ICC profiles to let you obtain accurate color from scanners, digital cameras, monitors, printers, and even color copiers. The software has an interface that guides users through the profiling process and displays on-screen images accurately to produce "soft" proofs. Some ink jet printers bundle a copy of Monaco EZcolor Lite that lets you create a single monitor profile for your system.

A great companion to ColorVision's Spyder2 is their Profiler software, which color-manages desktop printers. ColorVision provides target files that you output on your printer. After you digitize that output with 'our scanner, Profiler RGB compares your image with he original file and creates a unique profile for a specific paper/ink/printer combination.

f you're serious about color management, you might vant to check out another ColorVision product.)octorPro software lets you edit RGB and CMYK printer files and uses Photoshop's capabilities to crete adjustment scripts for editing output profiles, including color cast removal, opening shadows, correcting color mismatches, as well as adjusting bright-Less, saturation, and contrast.

onOne Software Intellihance Pro offers many image enhancement capabilities, including multiple preview panes and test strips that function similarly to a darkroom test strip. Its digital test proof shows what the image looks like with user-specified increments of additional cyan, yellow, and magenta, or red, blue, and green, so you can see how much of what color to add in the printer driver to get a print that matches your creative vision. This plug-in is available for either Mac OS or Windows, and you can download trial versions from the onOne Software website.

Check out all of these possibilities with an eye toward affordability as well as compatibility with your system and workflow.



Intellihance Pro has a feature that functions much like a traditional darkroom test strip.

Ink on Paper

Four-color ink jet printers have the same cyan, yellow, magenta, and black (C, Y, M, K) color process used by commercial printing presses. To reproduce delicate colors and textures such as skin tones and metallic surfaces, six color printers usually add light cyan and light magenta. Some Epson printers use seven or eight colors, adding a light black, red, and/or gloss optimizers for more depth and better monochrome reproduction. There is a trend to keep adding more colors. Most desktop ink jet printers use one or two ink cartridges, but professional ink jet printers typically have a separate cartridge for each color, something Canon originally popularized for desktop photo printers.

Not all ink jet printers have the same ink formulations. Some companies use pigmented-based inks for their black ink cartridge and dye-based inks in their color cartridges, while others use all dye-based inks or all pigmented inks. Why do you care? Pigment inks last longer but are not as vibrant; dye based inks are colorful but have less longevity. On plain paper, dye and pigmented inks mix easily because of this medium's high ink absorption rate. But when printing on coated stock, such as photo paper, printers with different types of inks turn off the black ink. (Black in the output then becomes a composite of the CMY inks.) Pigmented black ink is slightly better than dye-based ink for printing sharp, dense, black text on plain paper, and some manufacturers prioritize black text over photo quality. Epson's UltraChrome inks, used in some desktop and large format printers, are water resistant and provide bright colors that are similar to dye-based inks, while retaining pigmented ink's lightfastness.

Because of these differences, selecting the paper type in the printer driver is a critical step in achieving the best possible output. Each type of paper shown in the printer software driver has different characteristics and different ink saturation. Thus, if you select the wrong paper—either by accident or on purpose—you'll get poor results.

So Waddaya Do to Get the Best Results?

• Read the paper's instruction sheets. Find out which driver settings are compatible with the paper and what settings should produce the best results.

• Not every paper and ink combination works together perfectly. Before making a big investment in papers, purchase a sampler pack or small quantity of a paper and make prints with your own test files (more on how to do this later). Write notes about the settings and paper on the back of the prints and put them away in a file for future reference.

Printer manufacturers claim you get the best printing and longest lasting results when using OEM (Original Equipment Manufacturer) ink. There are less expensive generic inks available, but using them will usually void your printer's warranty. I advise digital imagers who want to work with archival, grayscale, or generic ink sets to use separate printers. You may want to shop for a great value on a discontinued printer to use for your everyday work. Then you can experiment with it to your heart's content with whatever bargain, recycled, or home-brewed ink you want.

Profiles In Infrared: Rick Sammon

Rick Sammon is the host of two TV shows on the Do It Yourself (DIY) cable/satellite network: Photography Workshop and Digital Photography Workshop. He has appeared on every major morning show and hosted episodes of the Canon "Photo Safari," on the Outdoor Life Network. Show locales include Galapagos, Belize, Botswana, and Thailand. On these programs, Rick teaches celebrities how to take better pictures. His former students include Maria Conchita Alonzo, Dana Delany, John O'Hurley, and Kelly Packard.

Rick is the author of 22 books and he has written more than 1,000 articles on photography, travel, wildlife, and conservation. Since 1990 he has been the photography columnist for the Associated Press—a column that garners about 10 million readers a week. Rick also writes 12 travel features for the Associated Press each year. All of these make Rick the most frequently published photographer/writer in the world.

He also teaches at some of the most prestigious photo workshops in the country: Maine Photographic Workshop and Palm Beach Photo Workshop. In addition, Rick teaches workshops for *Popular Photography* and *Imaging* magazines. These workshops (more than 20 in the past 5 years) have taken him to China, Costa Rica, and throughout the United States. A member of the Explorers Club, Rick has documented cultures in Brazil, Nepal, India, Cuba, Thailand, Indonesia, Papua New Guinea, and Costa Rica.

Rick's website, loaded with photos and information, can be found at www.ricksammon.com



Here's a perfect example of the clarity and even tonality that a digital IR file offers over grainy film IR. This RAW file was made using an IR-converted Canon EOS digital SLR. 1/30 second; f/22; ISO 200. Photo ©Rick Sammon.



Rick Sammon may be most famous for his travel photographs, but his IR work shows that he's a darn good infrared landscape photographer too. He shot this pastoral IR scene as a RAW file using a Canon EOS digital SLR that has been converted for IR-only operation. 1/60 second; f/22; ISO 400. Photo ©Rick Sammon.

Black and White in Color

One of the biggest challenges is making black-and-white or monochromatic prints with IR image files. This can be a problem with ink jet printers because the monochrome prints they produce may be cool or warm-toned (not neutral). With printers that use pigmented inks, metamerism (repeated banding) often rears its colorful ugly head. You can always print using the option for black ink only, and I have successfully produced prints this way, but the results may vary based on the characteristics of the original image.

To get truly continuous tone black-and-white prints, you need a grayscale inkset. These inksets and complimentary software are available from companies such as Media Street and Lyson. These companies offer archival quality inks that when used with acid-free paper produce museum-quality giclee images, which can be sold in art galleries anywhere in the world. (See my note on page 139 about printer warranties.)

Printer manufacturers including Epson and HP have started offering printers that will print monochrome images using additional black ink cartridges. Epson currently offers a printer with a maximum print size of 13 x 19 inches (33 x 48 cm). It is delivered with nine inks, including user-interchangeable Photo Black and Matte Black cartridges. With an expanded inkset, which includes black, light black, and light-light black inks, the Epson R2400 when properly set produces beautiful black and white prints that should last up to 200 years, and color prints that are fade-resistant for up to 108 years.



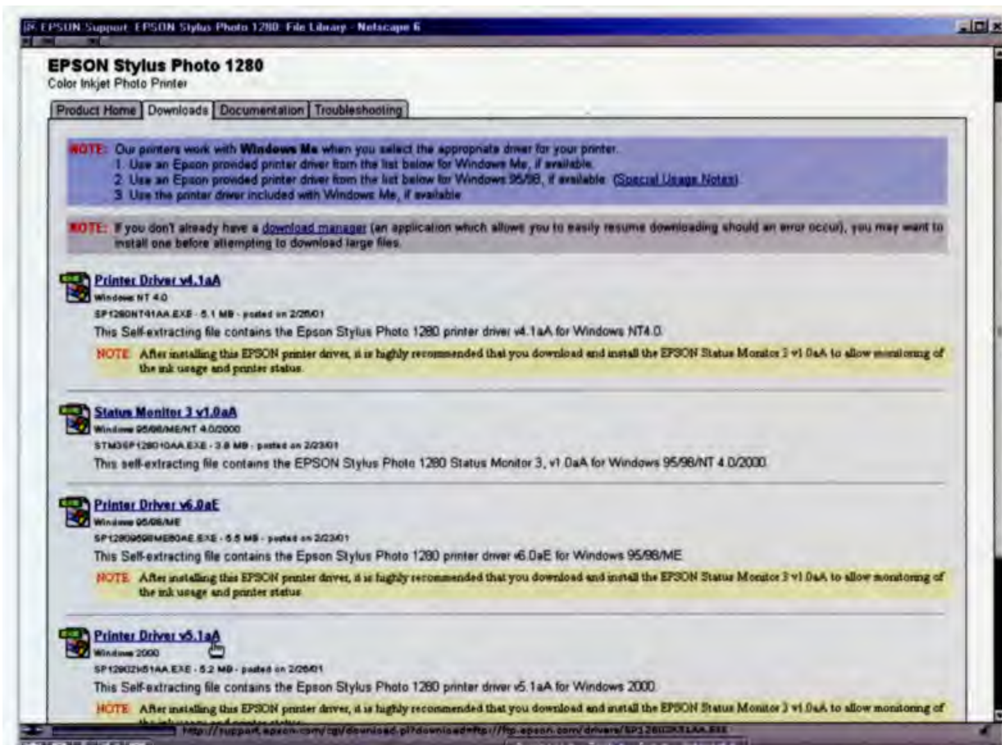
With its full range of inks and Epson papers, the Epson R2400 produced a deliciously warm print of this monochrome IR image file, which I like. However, if you don't care for the warmth, you can use the Advanced section of the printer's driver to select "Black and White Printing." In this case, only the printer's three black inks will be used and the resulting prints will be as neutral as Switzerland.

Printing Challenges

Sometimes it seems that different people can get different results from the same photographic file printed with the same model ink jet printer on the same paper. How is this possible? It is because one of these photographers is getting the most out of the printer's driver, while the others are just clicking the "Print" button. I get questioned all the time by people who ask why the prints made with my printer look different from those that they're making with the same brand and model of ink jet printer.

Here's some advice on a few steps you can take to improve print quality before even starting to work with your printer's software:

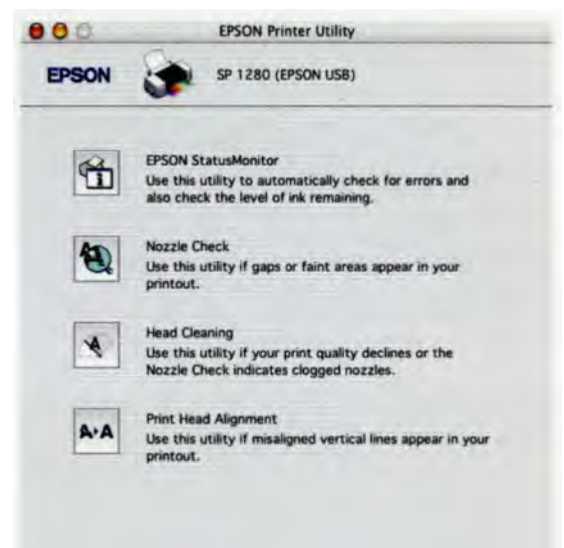
• Download the latest printer driver. Don't assume that just because you unpacked a brand new printer you'll have the latest driver. Oh contraire, mon frère. It may be that some bugs have been fixed or support



Check your printer manufacturer's website periodically to see if there are driver updates.

has been added for new kinds of paper. Take the time to go to your printer manufacturer's website and download the most current driver, then install it.

• Clean the printer heads! Many times when photographers show me ink jet prints and ask what's wrong with them, the answer is simply that the heads are clogged. How do heads get dirty? If the printer is left on and not used regularly, air gets into the heads and clogs the ink. Make sure you have the printer turned OFF unless you plan to use it. Plus, print heads get dirty or clogged from not being used, so try to use them every day. But mostly ink jet print heads get dirty because that's what they do.



Until somebody invents a self-cleaning head for ink jet printers, you'll have to clean the heads periodically, wasting precious Dom Perignon-priced ink in the process. Hey, we used to scrub ovens by hand too; now self-cleaning ovens make that chore a cinch. So maybe somebody will figure out something similar for ink jet printers.

• Read the instruction manual. If you do this before you make your first print, you'll discover there are often several utilities that will help your printer produce the best possible results. With new Epson ink jet printers, it's always a good idea to run both the Head Alignment and Nozzle Check utilities before putting in any "good" paper and making a print. Some new printers run two head alignment tests, one for black ink, the other for color. When you run these tests, it's a good idea to evaluate the output using a high-quality magnifying loupe so that the feedback you provide the utility is as accurate as possible.

Get to Know Your Printer Driver

Some printers have built-in calibration routines that set up the device after you've made your initial connections. With most computer systems, these will likely happen when the printer driver is installed, but you may also need to recalibrate it from time to time.



HP's PhotoSmart Toolbox software, that's bundled with their printers, lets you perform an automated series of diagnostics and corrections, and when completed it prints a test page.

No matter what brand of printer you use, its driver software has a number of controls that allow you to print on different kinds of paper, usually those offered by the printer manufacturer. While you can use software such as ColorVision's Profiler RGB to precisely calibrate a specific kind of paper for your printer, the driver itself provides controls that let you fine tune the color, density, and contrast of your output. I liken these controls to manually tweaking a color enlarger in a traditional darkroom.

Printer drivers do more than just direct your computer to send data to the printer. In most cases, the drivers let you specify information about the kind of paper you're using and how you want the finished print to appear. You can simply pick the kind of paper you're using, click the "Automatic" button, set the slider to "Quality" and you'll usually get a pretty good print, but it may not be the best possible print. Just as you sometimes need to take your camera off automatic mode and apply your photographic knowledge and experience, you may want to take manual control over the digital printing process.



Many ink jet printers' drivers allow full manual control of brightness, contrast, saturation, and color. But before you work with these controls, it's a good idea to create a personal test-print file.

With most drivers, you can tweak the brightness or contrast settings as well as the color balance to get better results. Also, before making a print, take a look at the advanced settings that are available in the driver.



Inkjet Art Solutions' website contains several different test files. The one I use is the PhotoDisc test file that contains many difficult-to-print colors and skin tones, plus a grayscale target, as well. Photo courtesy of Inkjet Art Solutions.

Making a Personal Test Print

Some ink jet printers automatically output a test page shortly after you connect to the computer and install the driver. While these pages may tell you that the printer is actually working, you may want more information than that. One of the best ways to discover your printer's capabilities is to create and print a "personal" test print.

Comparing test prints is one of the best ways to evaluate different printers as well as different types of paper. I'm not talking about the kind of test prints seen in computer and electronics stores where you press a button and output rolls from the printer. While these files are usually optimized to make the printer look good, the output can be compromised if the paper used is either the best or cheapest available. In this kind of setting, there are too many variables present to use these prints in comparing one printer to another. The key to comparing results from different printers or papers is to create a standardized test file and use it.

I have established two separate files that I use as standards to test new printers, inks, and papers. One is the PhotoDisc target that can be downloaded from Inkjet Art Solutions. The other is an image that I created with a digital SLR and contains reference colors such as skies, neutral grays, and skin tones. Whenever I get a new printer, new inks, or a new paper type, I run test prints to see if any adjustments are needed in the printer driver or software color settings to produce the desired results.

Your personal test file should reflect your typical image, such as an IR landscape. Use your favorite image-processing program to save the photograph in a high-resolution format such as TIFF. Instead of making the image 8 x 10 inches (20 x 25 cm), keep it around 5 x 7 inches (13 x 18 cm). This will make the file size smaller and it will take less time to print. The file should then be saved on some kind of portable media, such as recordable CD/DVD, so it can be used in the future for testing new printers, inks, or papers.

Start by printing the test image on your own printer, but you might also ask a friend if you can output it on their printer so you both can run the test to compare results. Use the test print with the printer driver's advanced settings and experiment with the slider settings for brightness or contrast. Then take a look at color bias. Monochrome prints will clearly show color shifts attributable to the paper, inks, or printer because color shifts will be more apparent with a grayscale image. Working with your customized test file will let you know what driver settings will produce results you like and can also be a big help when evaluating different paper types or brands. After a little testing, you'll find the paper and settings that will produce the optimum quality output from your printer.

Keep these test prints in a folder or some other type of dark storage for future reference. Write technical information on the back of the print, including what paper and ink were used, printer's settings, printer model, and the date print was made.

Ink Jet Papers

The ink jet paper you use can have a dramatic effect on the quality of your print. Printer manufacturers often insist that the best results will be produced by using their papers, and this advice often does give spectacular prints. But we wouldn't be photographers if we weren't looking for something different, would we? When working in a traditional darkroom, I used Agfa, Ilford, and Kodak papers and would try to fit my choice of paper to the image. Now I keep papers from Epson, Media Street, Moab Paper, and others on hand, using the same concept of matching paper to the image's mood.

I like glossy shiny papers such as Epson Premium Glossy Photo Paper and Konica's Professional Glossy QP for photographs of automobiles and other shiny machines. Portraits look fabulous on Moab's Kayenta matte paper, but don't be bound by these dictums. Adorama offers a true heavyweight paper that's double-sided matte and perfect for presentations and portfolios. Complementing their double-sided matte is a double-sided matte gloss and a royal satin, which has a fine "pearl" surface.

Experimenting with different kinds of papers with interesting textures and ink absorption characteristics can be fun, but judging from the questions I get during workshops, this is often where fun goes out of the process. The stock answer to keeping this from getting troublesome is that you should create a custom profile that is printer, ink, and paper specific. Many photographers who are new to working digitally don't want the hassle. But some forward-thinking paper companies are taking steps to put the creativity back into printing by producing generic profiles for each of their papers with different kinds of ink jet printers. I used to go to the art supply store to find papers with interesting textures, but now papermakers are offering interesting surfaces.

While the safest way to get the best possible results is to use the inks and papers produced by the printer manufacturer, it isn't always the way to the most exciting print. If you are still not satisfied with your prints, before running off to try other inks and papers,

make sure that the printer itself is capable of providing the best possible results. It may not be. If your friends and colleagues are getting better results than you, the place to start trying to improve is the printer driver. Only after you've first optimized the printer to produce the best possible results should you start looking for ways to improve your printer output.

Long Lasting Prints

The best way to ensure a print's longevity is to take a few simple steps:

- Allow prints to dry for twenty-four hours before framing them. Avoid framing when humidity is high because condensation can form behind the glass. Don't hang prints in direct sunlight or display prints outdoors.

- Allow prints to dry for at least fifteen minutes before stacking them. Place a sheet of plain paper (I use copier paper) between the individual prints when stacking. Allow a full day for prints to dry before removing the separator sheets. And don't force-dry prints with a hair dryer.

- Keep prints away from sources of ozone. This includes such things as computer monitors, television, air cleaners, or high voltage electricity. Don't store prints, or digital paper for that matter, where they will be exposed to chemicals such as in a traditional darkroom.

- Use acid-free archival sleeves when storing prints in photo albums.

- Finally, visit Wilhelm Research's website (www.wilhelm-research.com) often. This site is regularly updated with information on the stability and longevity of new inks and papers.



Profiles In Infrared: Steve and Aaron Cathcart

Steve and Aaron Cathcart (www.cathcartphoto.com) are a father and son who have been photographing weddings in the Estes Park, Colorado area for more than ten years. Steve is a second-generation photographer, which makes his son Aaron a third-generation photographer.

The idea of shooting infrared appealed to Aaron, so he bought an IR filter for his Nikon digital SLR and started to experiment. He enjoys shooting IR in the Colorado mountains, and since most people are not familiar with infrared photography, his unusual-looking landscapes are something different to show to his clients. The photos have a dream-like quality that cannot be totally duplicated, no matter how much creative work is applied to an image in Photoshop.

Aaron also shoots IR at certain weddings, especially if a composition includes foliage. Some brides specifically ask for infrared photos and love the results. Aaron acknowledges that one key to IR success "is to shoot lots of photos and bracket. But," he adds with jokingly, "I don't want to give away all my secrets."



Photo ©Aaron Cathcart



Both of these IR images were shot by Aaron Cathcart in Estes Park, Colorado using a Nikon D1X with a Wratten #87 filter. In the photo above, some of the trees in the foreground are deciduous and are rendered in white, while the trees in the background are evergreens that reflect very little IR. The sky lacks the dark tones shown in Aaron's other image here (see left), showing how differently IR photography will interpret a scene based on its content of IR wavelengths. Photo ©Aaron Cathcart.



WEBSITE RESOURCES

Sensor/Camera Cleaning

Intelligent Mobile Solutions UK (www.intemos.com)

Photographic Solutions (www.photosol.com)

Visible Dust (www.visibledust.com)

Infrared Filters

Cokin (www.cokin.com)

Eastman Kodak Company (www.kodak.com)

Heliopan (www.hpmarketingcorp.com)

Hoya (www.hoyaoptics.com)

Lee (leefilters.com)

Schneider Optics (B+W) (www.schneideroptics.com)

Singh Ray (www.singh-ray.com)

Tiffen (www.tiffen.com)

Dedicated IR Cameras and Camera Conversion

Hutech Astronomical Products (www.sciencecenter.net/hutech/irphoto/ir.htm)

IR Guy (www.irdigital.net)

LDP (www.maxmax.com)

Life Pixel (www.lifepixel.com)

IR Information, Resources and General Photographic Sites

Blue Pixel (www.bluepixel.net)

Digital Infrared Resource Page (folk.uio.no/gisle/photo/ir.html)

Digital Photography For What It's Worth (www.dpfwiw.com/ir.htm)

Digital Photography Review (www.dpreview.com)

Electronic Photo Imaging (www.epi-centre.com)

Thom Hogan (www.bythom.com/infrared.htm)

Imaging Resource (www.imaging-resource.com)

Lensmate On Line (www.lensmateonline.com)

Luminous Landscape (www.luminous-landscape.com)

Macintosh Maintenance & Diagnostics (www.macmdcare.com)

Willem-Jan Markerink (www.al.nl/phomepag/markerink/mainpage.htm)

Megapixel (www.megapixel.net)

PC Photo Magazine (www.pcphotomag.com)

Ken Rockwell (www.kenrockwell.com/tech/ir.htm)

Rocky Mountain Film Lab (www.rockymountainfilm.com)

Steve's Digicams (www.steves-digicams.com) Vivid

Light Photography (www.vividlight.com)

Wilhelm Imaging Research (www.wilhelm-research.com)

Wet Pixel (www.wetpixel.com)

Andrzej Wrotniak (www.wrotniak.net/photo/infrared)

Image-Processing Software Products

About Digicam (http://aboutdigicam.com)

Adobe Studio Exchange (http://share.studio.adobe.com)

Adobe Systems (www.adobe.com)

Alien Skin Software (www.alienskin.com)

Andromeda Software (www.andromeda.com)

ArcSoft (www.arcsoft.com)

Auto FX Software (www.autofx.com)

Corel (www.corel.com)

Craig's Actions (www.craigsactions.com)

Eastman Kodak Company

Austin Development Center (www.asf.com) Flaming

Pear Software (www.flamingpear.com) Imagenomic

(www.imagenomic.com)

The Imaging Factory (www.theimagingfactory.com)

Fred Miranda (www.fredmiranda.com) Nik Software

(www.niksoftware.com) on One Software (www.

ononesoftware.com) PictureCode (www.picturecode.

com) Pixel Genius (www.pixelgenius.com) Power

Retouche (www.powerretouche.com) Silver Oxide

(www.silveroxide.com) Ulead Systems

(www.ulead.com) Visual Infinity (www.visinf.com)

Display: Calibration, Color Management, and Scanning Products

GretagMacbeth (www.gretagmacbeth.com)

DisplayMate Technologies (www.displaymate.com)

ColorVision Datacolor (www.colorvision.com)

International Color Consortium (ICC) (www.color.org)

Monaco by X-Rite (www.xritephoto.com)

Inkjet Art Solutions (www.inkjetart.com/custom)

LaserSoft Imaging (www.silverfast.com)

Ott-Lite Technology (www.ottlite.com)

Inkjet Printing

Eastman Kodak Company (www.kodak.com)

Canon (www.canon.com)

Dell (www.dell.com)

Epson (www.epson.com)

Hewlitt-Packard Development (www.hp.com)

Lexmark International (www.lexmark.com)

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Glossary

aberration: An optical flaw in a lens that causes the image to be distorted or unclear.

Adobe Photoshop: Professional-level image-processing software with extremely powerful filter and color-correction tools. It offers features for photography, graphic design, web design, and video.

Adobe Photoshop Elements: A limited version of the Photoshop program, designed for the avid photographer. The Elements program lacks some of the more sophisticated controls available in Photoshop, but it does have a comprehensive range of image-manipulation options, such as cropping, exposure and contrast controls, color correction, layers, adjustment layers, panoramic stitching, and more.

AE: See automatic exposure.

AF: See automatic focus.

AI: Automatic Indexing.

aliasing: Jagged edges or a "stair step" appearance that become visible, especially along diagonal lines, in digital images and graphic displays due to the shape of pixels.

ambient light: See available light.

analog: Information presented in continuous form. A traditional photographic print is an analog form, but when this same image is scanned and converted into digital form, it is made up of bits.

angle of view: The area seen by a lens, usually measured in degrees across the diagonal of the film frame.

anti-aliasing: A technique that reduces or eliminates the jagged appearance of lines or edges in an image.

aperture: The opening in the lens that allows light to enter the camera. Aperture is usually described as an f/number. The higher the f/number, the smaller the aperture; and the lower the f/number, the larger the aperture.

Aperture-priority mode: A type of automatic exposure in which you manually select the aperture and the camera automatically selects the shutter speed.

artifact: Information that is not part of the scene but appears in the image due to technology. Artifacts can occur in film or digital images and include increased grain, flare, static marks, color flaws, noise, etc.

artificial light: Usually refers to any light source that doesn't exist in nature, such as incandescent, fluorescent, and other manufactured lighting.

automatic exposure: When the camera measures light and makes the adjustments necessary to create proper image density on sensitized media.

automatic flash: An electronic flash unit that reads light reflected off a subject (from either a preflash or the actual flash exposure), then shuts itself off as soon as ample light has reached the sensitized medium.

automatic focus: When the camera automatically adjusts the lens elements to sharply render the subject.

Av: Aperture Value. See Aperture-priority mode.

available light: The amount of illumination at a given location that applies to natural and artificial light sources but not those supplied specifically for photography. It is also called existing light or ambient light.

backlight: Light that projects toward the camera from behind the subject.

bit depth: The number of bits per pixel that determines the number of colors the image can display. Eight bits per pixel is the minimum requirement for a photo-quality color image.

bitmap: A computer-screen display made up of individual pixels.

bounce light: Light that reflects off of another surface before illuminating the subject.

bracketing: A sequence of pictures taken of the same subject but varying one or more exposure settings, manually or automatically, between each exposure.

brightness: A subjective measure of illumination. See also, luminance.

built-in flash: A flash that is permanently attached to the camera body. The built-in flash will pop up and fire in low-light situations when using the camera's automated exposure settings.

built-in meter: A light-measuring device that is incorporated into the camera body.

byte: A single group of eight bits that is processed as one unit. See also, bit.

card reader: Device that connects to your computer and enables quick and easy download of images from memory card to computer.

CCD: Charge Coupled Device. This is a common digital camera sensor type that is sensitized by applying an electrical charge to the sensor prior to its exposure to light. It converts light energy into an electrical impulse.

chromatic aberration: Occurs when light rays of different colors are focused on different planes, causing colored halos around objects in the image.

chrominance: A component of an image that expresses the color (hue and saturation) information, as opposed to the luminance (lightness) values.

chrominance noise: A form of artifact that appears as a random scattering of densely packed colored " grain." See also, luminance and noise.

close-up: A general term used to describe an image created by closely focusing on a subject. Often involves the use of special lenses or extension tubes. Also, an automated exposure setting that automatically selects a large aperture (not available with all cameras).

CMOS: Complementary Metal Oxide Semiconductor. Like CCD sensors, this sensor type converts light into an electrical impulse. CMOS sensors are similar to CCDs, but allow individual processing of pixels, are less expensive to produce, and use less power. See also, CCD.

CMYK mode: Cyan, magenta, yellow, and black. This mode is typically used in image-processing applications when preparing an image for printing.

color balance: The average overall color in a reproduced image. How a digital camera interprets the color of light in a scene so that white or neutral gray appear neutral.

color cast: A colored hue over the image often caused by improper lighting or incorrect white balance settings. Can be produced intentionally for creative effect.

color depth: See bit depth.

color space: A mapped relationship between colors and computer data about the colors.

CompactFlash (CF) card: One of the most widely used removable memory cards.

compression: A method of reducing file size through removal of redundant data, as with the JPEG file format.

contrast: The difference between two or more tones in terms of luminance, density, or darkness.

critical focus: The most sharply focused plane within an image.

cropping: The process of extracting a portion of the image area. If this portion of the image is enlarged, resolution is subsequently lowered.

dedicated flash: An electronic flash unit that talks with the camera, communicating things such as flash illumination, lens focal length, subject distance, and sometimes flash status.

default: Refers to various factory-set attributes or features, in this case of a camera, that can be changed by the user but can, as desired, be reset to the original factory settings.

depth of field: The image space in front of and behind the plane of focus that appears acceptably sharp in the photograph.

diaphragm: A mechanism that determines the size of the lens opening that allows light to pass into the camera when taking a photo.

digital zoom: The cropping of the image at the sensor to create the effect of a telephoto zoom lens. The camera interpolates the image to the original resolution. However, the result is not as sharp as an image created with an optical zoom lens because the cropping of the image reduced the available sensor resolution.

diopter: A measurement of the refractive power of a lens. Also, it may be a supplementary lens that is defined by its focal length and power of magnification.

download: The transfer of data from one device to another, such as from camera to computer or computer to printer.

dpi: Dots per inch. Used to define the resolution of a printer, this term refers to the number of dots of ink that a printer can lay down in an inch.

DVD: Digital Video Disc. These discs store more information that CDs.

electronic flash: A device with a glass or plastic tube filled with gas that, when electrified, creates an intense flash of light. Also called a strobe. Unlike a flash bulb, it is reusable.

EV: Exposure value. A number that quantifies the amount of light within an scene, allowing you to determine the relative combinations of aperture and shutter speed to accurately reproduce the light levels of that exposure.

EXIF: Exchangeable Image File Format. This format is used for storing an image file's interchange information.

exposure: When light enters the camera and reacts with the sensitized medium. The term can also refer to the amount of light that strikes the light sensitive medium.

exposure meter: See light meter.

file format: The form in which digital images are stored and recorded, e.g., JPEG, RAW, TIFF, etc.

filter: Usually a piece of plastic or glass used to control how certain wavelengths of light are recorded. A filter absorbs selected wavelengths, preventing them from reaching the light sensitive medium. Also, software available in image-processing computer programs can produce special filter effects.

FireWire: A high speed data transfer standard that allows outlying accessories to be plugged and unplugged from the computer while it is turned on. Some digital cameras and card readers use FireWire to connect to the computer. FireWire transfers data faster than USB.

firmware: Software that is permanently incorporated into a hardware chip. All computer-based equipment, including digital cameras, use firmware of some kind.

flare: Unwanted light streaks or rings that appear in the viewfinder, on the recorded image, or both. It is caused by extraneous light entering the camera during shooting. Diffuse flare is uniformly reflected light that can lower the contrast of the image. Zoom lenses are susceptible to flare because they are comprised of many elements. Filters can also increase flare. Use of a lens hood can often reduce this undesirable effect.

f/number: See f/stop.

focal length: When the lens is focused on infinity, it is the distance from the optical center of the lens to the focal plane.

focal plane: The plane on which a lens forms a sharp image. Also, it may be the film plane or sensor plane.

focus: An optimum sharpness or image clarity that occurs when a lens creates a sharp image by converging light rays to specific points at the focal plane. The word also refers to the act of adjusting the lens to achieve optimal image sharpness.

f/stop: The size of the aperture or diaphragm opening of a lens, also referred to as f/number or stop. The term stands for the ratio of the focal length (f) of the lens to the width of its aperture opening. (f/1.4 = wide opening and f/22 = narrow opening.) Each stop up (lower f/number) doubles the amount of light reaching the sensitized medium. Each stop down (higher f/number) halves the amount of light reaching the sensitized medium.

full-frame: The maximum area covered by the sensitized medium.

full-sized sensor: A sensor in a digital camera that has the same dimensions as a 35mm film frame (24 x 36 mm).

gamma: A measurement of the contrast that affects midtones in an image. Gamma settings differ between operating systems for Macintosh (1.8 setting) and Windows (2.2).

gamut: The full range of colors that a printer, monitor, or other computer peripheral can accurately reproduce. Different devices have different gamuts, requiring the need for color management systems to provide consistency between them.

GB: See gigabyte.

gigabyte: Just over one billion bytes.

gray card: A card used to take accurate exposure readings. It typically has a white side that reflects 90% of the light and a gray side that reflects 18%.

gray scale: A successive series of tones ranging between black and white, which have no color.

hard drive: A contained storage unit made up of magnetically sensitive disks.

histogram: A graphic representation of image tones.

hot shoe. An electronically connected flash mount on the camera body. It enables direct connection between the camera and an external flash, and synchronizes the shutter release with the firing of the flash.

ICC: The International Color Consortium, a group of eight large manufacturers in the computer and digital imaging industries. The consortium works to a dvance a common foundation for cross-platform color communication and has established base-level standards and protocols in the form of ICC Profile Format specifications.

image-editing program: See image-processing program.

image-processing program: Software that allows for image alteration and enhancement.

interpolation: A process used to increase image resolution by creating new pixels based on existing pixels. The software intelligently looks at existing pixels and creates new pixels to fill the gaps and achieve a higher resolution.

IS. Image Stabilization: A technology that reduces camera shake and vibration.

ISO: A term for industry standards from the International Organization for Standardization. When an ISO number is applied to film, it indicates the relative light sensitivity of the recording medium. Digital sensors use film ISO equivalents, which are based on enhancing the data stream or boosting the signal.

JPEG: Joint Photographic Experts Group. A lossy compression file format that works with any computer and photo software. JPEG examines an image for redundant information and then removes it. It is a variable compression format because the amount of leftover data depends on the detail in the photo and the amount of compression. At low compression/high quality, the loss of data has a negligible effect on the photo. However, JPEG should not be used as a working format—the file should be reopened and saved in a format such as TIFF, which does not compress the image.

KB: See kilobyte.

kilobyte: Just over one thousand bytes.

layer: A tool in image-processing programs that creates separate versions of an image, each of which can be manipulated independently. The separate layers can then be used to form a composite image.

LCD: Liquid Crystal Display. A flat screen with two clear polarizing sheets on either side of a liquid crystal solution. When activated by an electric current, the LCD causes the crystals to either pass through or block light in order to create a colored image display.

lens: A piece of optical glass on the front of a camera that has been precisely calibrated to allow focus.

lens hood: Also called a lens shade, it is a short tube that can be attached to the front of a lens to reduce flare. It keeps undesirable light from reaching the front of the lens and also protects the front of the lens.

light meter: Also called an exposure meter, it is a device that measures light levels and calculates the correct aperture and shutter speed.

lossless: Image compression in which no data is lost.

lossy: Image compression in which data is lost and, thereby, image quality is lessened. This means that the greater the compression, the lesser the image quality.

low-pass filter: A filter designed to remove elements of an image that correspond to high-frequency data, such as sharp edges and fine detail, to reduce the effect of moire. See also, moire.

luminance: A term used to describe directional brightness. It can also be used as luminance noise, which is a form of noise that appears as a sprinkling of black "grain." See also, brightness, chrominance, and noise.

macro lens: A lens designed to be at top sharpness over a flat field when focused at close distances and reproduction ratios up to 1:1.

main light: The primary or dominant light source. It influences texture, volume, and shadows.

Manual exposure mode: A camera operating mode that requires the user to determine and set both the aperture and shutter speed. This is the opposite of automatic exposure.

mask: A method in image-processing programs to protect all or parts of an image from enhancement. Cutouts or openings in the mask allow unmasked portions of the image to be accessible for manipulation.

MB: See megabyte.

megabit: One million bits of data. See also, bit.

megabyte: Just over one million bytes.

megapixel: A million pixels.

memory: The storage capacity of a hard drive or other recording media.

memory card: A solid state removable storage medium used in digital devices. It can store still images, moving images, or sound, as well as related file data. There are several different types, including CompactFlash, SmartMedia, and xD, or Sony's proprietary Memory Stick, to name a few. Individual card capacity is limited by available storage as well as by the size of the recorded data (determined by factors such as image resolution and file format). See also, CompactFlash (CF) card, file format.

menu: A listing of features, functions, or options displayed on a screen that can be selected and activated by the user.

microdrive: A removable storage medium with moving parts. They are miniature hard drives based on the dimensions of a CompactFlash Type II card. Microdrives are more susceptible to the effects of impact, high altitude, and low temperature than solid-state cards are. See also, memory card.

midtone: The tone that appears as medium brightness, or medium gray tone, in a photographic print.

moire: Moire appears as a wavy pattern over the image and occurs when the subject has more detail than the resolution of the digital camera can capture.

noise: The digital equivalent of grain. It is often caused by a number of different factors, such as a high ISO setting, heat, sensor design, etc. Though usually undesirable, it may be added for creative effect using an image-processing program. See also, chrominance noise and luminance.

normal lens: See standard lens.

operating system (OS): The system software that provides the environment within which all other software operates.

overexposed: When too much light is recorded with the image, causing the photo to be too light in tone.

perspective: The effect of the distance between the camera and image elements upon the perceived size of objects in an image. It is also an expression of this three-dimensional relationship in two dimensions.

pixel: Derived from picture element. A pixel is the base component of a digital image. Every individual pixel can have a distinct color and tone.

plug-in: Third-party software created to augment an existing software program.

pre-flashes: A series of short duration, low intensity flash pulses emitted by a flash unit immediately prior to the shutter opening. These flashes help the TTL light meter assess the reflectivity of the subject.

profile: A file that "describes" how a device (e.g. camera, monitor, printer) associates color information with specifications created by the International Color Consortium (ICC).

Program mode: In Program exposure mode, the camera selects a combination of shutter speed and aperture automatically.

RAM: Random Access Memory. A computer's memory capacity, directly accessible from the central processing unit.

RAW: An image file format that has little or no internal processing applied by the camera. It contains 12-bit color information, a wider range of data than 8-bit formats such as JPEG.

RAW+JPEG: An image file format that records two files per capture; one RAW file and one JPEG file.

resolution: The amount of data available for an image as applied to image size. It is expressed in pixels or megapixels, or sometimes as lines per inch on a monitor or dots per inch on a printed image.

RGB mode: Red, Green, and Blue. This is the color model most commonly used to display color images on video systems, film recorders, and computer monitors. It displays all visible colors as combinations of red, green, and blue. RGB mode is the most common color mode for viewing and working with digital files onscreen.

saturation: The degree to which a color of fixed tone varies from the neutral, grey tone; low saturation produces pastel shades whereas high saturation gives pure color.

sharp: A term used to describe the quality of an image as clear, crisp, and perfectly focused, as opposed to fuzzy, obscure, or unfocused.

short lens: A lens with a short focal length—a wide-angle lens. It produces a greater angle of view than you would see with your eyes.

shutter: The apparatus that controls the amount of time during which light is allowed to reach the sensitized medium.

Shutter-priority mode: An automatic exposure mode in which you manually select the shutter speed and the camera automatically selects the aperture.

Single-lens reflex: See SLR.

SLR: Single-lens reflex. A camera with a mirror that reflects the image entering the lens through a pentaprism or pentamirror onto the viewfinder screen. When you take the picture, the mirror reflexes out of the way, the focal plane shutter opens, and the image is recorded.

small-format sensor: In a digital camera, this sensor is physically smaller than a 35mm frame of film. The result is that standard 35mm focal lengths act like longer lenses because the sensor sees an angle of view smaller than that of the lens.

standard lens: Also known as a normal lens, this is a fixed-focal-length lens usually in the range of 45 to 55mm for 35mm format (or the equivalent range for small-format sensors). In contrast to wide-angle or telephoto lenses, a standard lens views a realistically proportionate perspective of a scene.

stop down: To reduce the size of the diaphragm opening by using a higher f/number.

stop up: To increase the size of the diaphragm opening by using a lower f/number.

telephoto lens: A lens with a long focal length that enlarges the subject and produces a narrower angle of view than you would see with your eyes.

thumbnail: A small representation of an image file used principally for identification purposes.

TIFF. Tagged Image File Format. This popular digital format uses lossless compression.

tripod: A three-legged stand that stabilizes the camera and eliminates camera shake caused by body movement or vibration. Tripods are usually adjustable for height and angle.

TTL: Through-the-Lens, i.e. TTL metering.

Tv: Time Value. See Shutter-priority mode.

USB: Universal Serial Bus. This interface standard allows outlying accessories to be plugged and unplugged from the computer while it is turned on. USB 2.0 enables high-speed data transfer.

vignetting: A reduction in light at the edge of an image due to use of a filter or an inappropriate lens hood for the particular lens.

viewfinder screen: The ground glass surface on which you view your image.

wide-angle lens: A lens that produces a greater angle of view than you would see with your eyes, often causing the image to appear stretched. See also, short lens.

zoomlens: A lens that can be adjusted to cover a wide range of focal lengths.





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